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Engineering News-Record

An Experiment in Earth Road Construction

By Ben H. Petty

Reconstructing Sixteenth Street Viaduct in Denver

By Elsie Eaves

A Study of Vibration in Francis Type Waterwheels

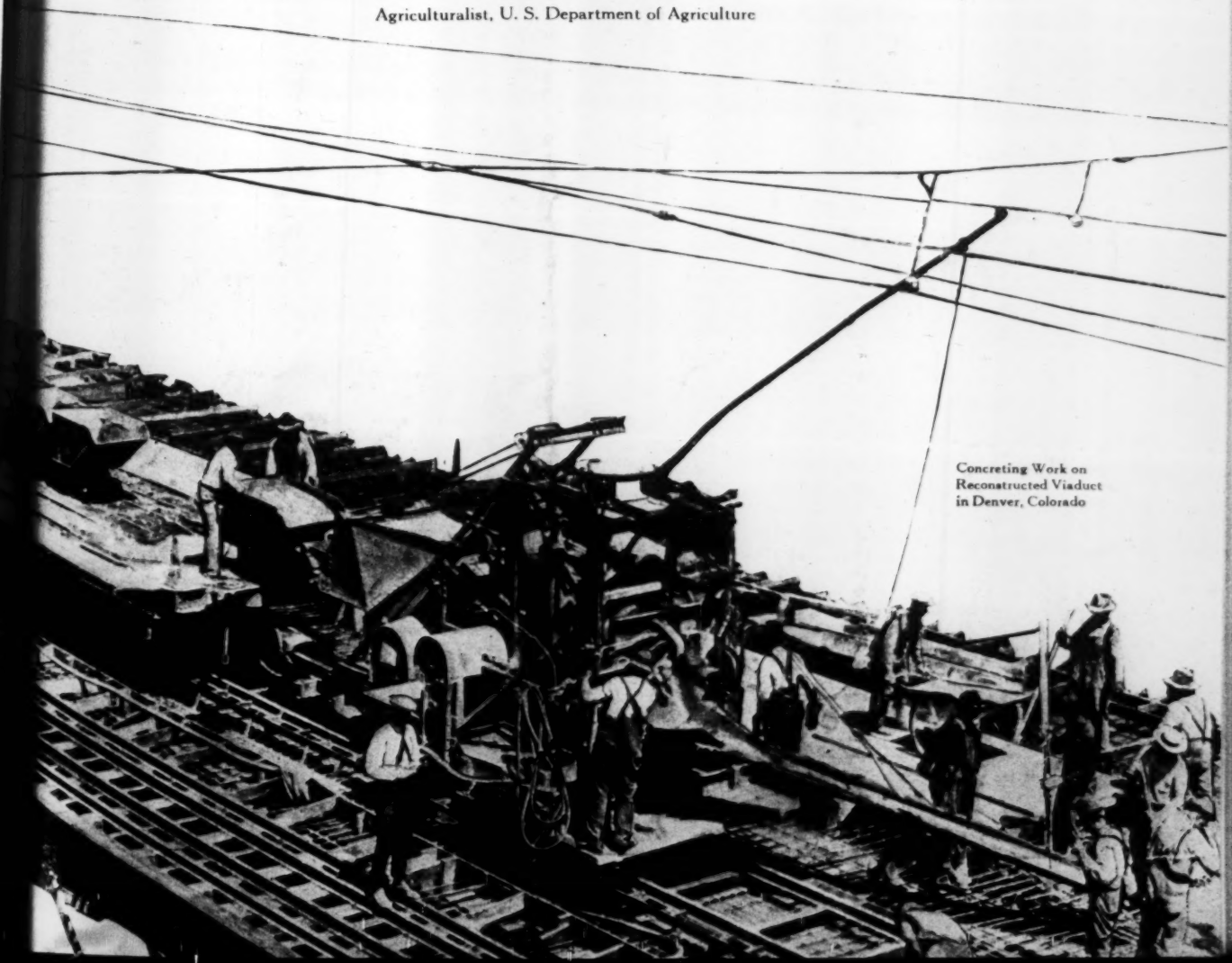
The third article in the series on

Federal Land Reclamation

in this issue treats of AGRICULTURE ON IRRIGATED LANDS *and is contributed by*

Carl S. Scofield

Agriculturalist, U. S. Department of Agriculture



Concreting Work on Reconstructed Viaduct in Denver, Colorado

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ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

E. J. MEHREN, *Editor*
FRANK C. WIGHT, *Managing Editor*

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Beginning Again

PREDICTION as to the effectiveness of the move toward co-operation initiated last week by the committee of the four national engineering societies is dangerous. It may mean the start of real effective co-ordination of engineering society effort in this country; it may be only a repetition of one of its several well intentioned predecessors which varied from the almost unanimously acknowledged failure, Engineering Council, to the debatable and debated Federated American Engineering Societies. The new co-operative effort has this in its favor—that it represents real co-operation and not assumption of composite authority. The deliberations of the joint conference will not commit the engineering profession to any expression of opinion or to any combined effort but they will serve for rapid interchange of society opinion and, in those cases where opinion in the four major branches is unanimous, they will promote the simultaneous action of those four branches. Society independence and professional integration may thus both be served. Whether this will be successful or not depends partly upon the care with which the joint conference does its early work but more particularly upon the attitude of the societies themselves toward the recommendations of the conference.

Water-Supply Co-operation in Jersey

TWO weeks ago we noted that low rainfall and runoff in the thickly settled portion of Northern New Jersey, with consequent water shortage in a large section, had stimulated adjacent municipalities to join with Newark in the Wanaque development being carried out for it by the North Jersey District Water Supply Commission. This movement has grown so rapidly since our earlier note that already the applications call for such a total as to convince both the commission and the interested municipalities that the Ramapo should be developed alongside the Wanaque. This feeling is accompanied by a growing belief that there should be joint public ownership and a co-ordinated development of all the sources of public water supply in North Jersey, both for economy's sake and to ensure an equitable division of the water without the inter-municipal and the private corporation conflicts that have prevailed for many years past. Some such plan was strongly urged by Allen Hazen in his masterly report of two years ago. Mr. Hazen suggested the creation of a new commission for this purpose. Since then, a court decision ruling that Bayonne could not proceed with its proposed Ramapo development without obtaining the consent of the North Jersey District Water Supply Commission as well as of the State Conservation and Development Commission, has indicated that a new agency is not required in law. All these things point to a promising beginning of the solution of the serious water problem confronting northeastern New Jersey. There is water aplenty for all this territory. Its wisest development may require supplementary legislation but the greater need has been such an awakening of public sentiment as would result in municipal co-operation to meet the common needs of scores of rapidly growing communities. That seems to have come.

Earthquake Effects

TAKEN together, the picture of Japanese building damage printed in this issue and the account of W. S. Sample, published last week, contain some of the most valuable information upon earthquake resistance and effects ever obtained. Previous earthquake visitations of modern cities have been far exceeded in violence by the recent one in Japan, and for the present it seems fair to assume that the Tokyo effects represent the maximum of earthquake action, for engineering purposes. It is a great satisfaction to know that the modern buildings fully withstood the shaking, so far as their framework is concerned. That the more rigid shell was cracked and broken in many places is not surprising, since forced distortion of any structure acts most severely on the least flexible elements. The earthquake study committee which has been formed by the American Society of Civil Engineers may succeed in discovering what is responsible for this cracking and how it may be avoided in future buildings, though at all events it is better to have a building cracked than shaken down into ruins. The subject is of primary interest of course to regions known to be visited by seismic disturbances; yet it is quite possible that such study will have equally useful bearing on methods of construction applicable to other regions. Strength and efficiency of construction are always closely related.

Capitalizing Traffic Congestion Cost

STRUCTURAL improvements to relieve traffic congestion are obvious necessities in most of our large cities. But such improvements cost money and the authorities are reluctant to enter into large capital expenditures when temporary alleviation can be had by the various expedients of signaling and manual control. Not infrequently, however, a proper analysis of cost will show that the capitalized cost of the expedient is greater than that of the major operation required to cure. Such an analysis is made for railway grade crossing improvement. When the capitalized cost of crossing flagmen begins to approach the first cost of a permanent crossover it is time to consider the construction of such a crossover. Take a similar situation in our cities. Traffic policemen are being demanded at more and more crossings. One such policeman a day costs the city the interest on $50,000. At the famous Fifth Ave. and 42nd St. crossing in New York City six to eight policemen are constantly on duty for at least two shifts. The city could afford to spend $800,000 for a structure here that would permit traffic crossing without control. These permissible first costs,

it should be noted, capitalize only the policeman charge; they take no account of the scattered savings, difficult to compute but no less existent, which would result from easy and rapid travel through our streets. Nor do they try to measure the immeasurable saving of life and limb that would result from a clear crossing.

A Bad Beginning

SITTINGS of Secretary Work's "fact finding commission" have begun, under that body's new name of Committee of Special Advisors on Reclamation. While we have had no illusions concerning the sincerity of purpose which led the secretary to appoint this body, in view of his disingenuous procedure in the ousting of Arthur P. Davis and his avowed purpose to smash the efficient administration of the Reclamation Service, we yet have felt hopeful that the committee would at least approximate to constructive and sound conclusions. This hope is seriously shaken by the method adopted by the committee. Opening its work by holding hearings, a lifeless method at best, it is doing the amazing thing of holding these hearings in secret. The very purpose of the committee's existence is to throw the light of publicity on the obscure and intricate subject of reclamation—and yet the committee itself shuns the light and does its work behind closed doors! Is it the committee's desire to command the public's confidence? The committee cannot gain or hold confidence by indulging in star-chamber procedure, certainly not in a subject that has become as embittered by personalities and political chicanery as the handling of reclamation by Secretary Work. It needs to change its method without delay, and work openly under the public eye. It also needs to protect its own good name by preventing the issuance of untruthful press reports of its secret hearings, such as have found their way into newspaper columns during the past week or two.

More Disorganization

EVEN while the Reclamation Service scandal is yet fully before the public, news comes that activities are under way in Washington which threaten a similar "reform" of other branches of the Interior Department. Investigations by secret agents—"inspectors" working by detective methods—are in progress, and by the example of what we learn of the activities of political "inspectors" in the Reclamation Service it is to be feared that disorganization and disruption of these other bureaus are only a question of time. To engineers the threat of serious injury to the efficiency of our national administration through the demoralization of such bodies as the geodetic and geological surveys will be apparent. But the matter is of public concern quite apart from its bearing on engineering interests. The new manager of a large industrial corporation who would seek to apply dark-lantern methods of the kind now current in the Interior Department would have a short and catastrophic career.

Contract Bond Reform

ALL attempts to set up standards of responsibility for contractors in road work will be largely futile as long as unrestricted bonding prevails. Given increasingly higher rates commercial bonding companies can extend the limits of risk almost indefinitely. Contract surety premiums have increased enormously in a decade. In pavement work there has been upwards of 1,000 per cent increase in 25 years. Surety companies claim that their increased rates are justified by the losses. In rebuttal contractors and highway engineers contend that the losses complained of are due to unwise risks which are constantly being taken in the strife for business and that the high commissions paid agents tempt them to accept hazardous business and even to conceal the full hazards from their home offices. Whereabouts justice lies in the controversy need not be inquired at the moment. The facts are that almost any contractor can get a surety bond and that a rate of 1½ per cent on the contract price is an absurd charge for the public to pay for safety against the real risks of highway work. Some way of changing the situation needs to be found. It is proposed in the conclusions of the joint committee of the Associated General Contractors and the Association of State Highway Officials, ratified by both associations in convention last year, that negotiable securities be substituted for surety bonds and that 35 per cent of the contract price is sufficient security for any highway work not extremely hazardous. Until laws are changed this practice is not generally possible and in no event can the highway official refuse a bond, if it is offered, or the contract, if the bonded bidder has named the lowest price. The argument returns then to the need of reform in bonding practice if standards of responsibility for contractors are to be set up with any hope that they can be successfully applied in canvassing bidders.

Business Engineering

MORE or less jocularly we have called attention to a number of curious engineers who seem to swarm the country—"hot dog engineers" and "matrimonial engineers" and "business engineers." Some of those specialists were readily recognized but we must confess we were not able to discover what the "business engineer" was until the other day we ran across a circular from a reputable firm of engineers engaged in industrial work which contained the following paragraphs:

> Three terms—"plan," "structural design" and "income"—are the key terms of business engineering.
>
> The "plan" for any investment building must be foundationed on something deeper than architectural considerations; it must rest on the fundamental service or production needs and the growth possibilities of the business. The "structural design" must not only be good architecturally and engineeringly, but it must also have a correct relation to production or service requirements, to load factors, and to the cost of construction and maintenance. But no matter how good a building or a plant may be architecturally, how well planned it may be from a construction standpoint, or how well suited to its service or production requirements, unless it has the right relation to the *possible income from the investment*, it is not good business engineering.
>
> That, then, marks the difference between construction work and business engineering: one is building; the other is building in *relation to potential income and growth*. One is a matter of blue prints, building materials and labor; the other embraces all of these things, and in addition the building in of sound investment values.

This contains excellent advice. We have only one quarrel with it. It sets up a distinction between engineering and "business engineering" which does not really exist and implies to the lay mind, to whom the circular is addressed, that engineering *per se* has no concern with economics but is merely the skillful putting together of materials into usable machines or structures. This, as all engineers know, is false. Engineering is essentially economics—it is doing for one dollar what any fool can do for two, not only in the spending of the first cost dollar but also in the continued spending of the operating and the maintaining dollar. This is elementary engineering science and engineers who pretend that by practicing it they are doing something ahead of the run of their fellows are not fair to their own profession.

Vibration in Hydraulic Turbines

IN VIEW of the progress in recent years in the design and construction of hydraulic turbines, with their sensitive automatic control devices and the nicety of balance that is now attained, it is a decided shock to hear of a large unit being actually installed with something so far wrong in its design as to prevent successful operation. Elsewhere in this issue reference is made to a 40,000-hp. water wheel which, on being put in service, vibrated so seriously that the power company shut it down and finally corrected the trouble, or at least reduced it to safe limits, by the comparatively rough method of decreasing the runner diameter 5 in. by cutting metal off the runner around its entire circumference with an oxy-acetylene torch.

A paper before the American Institute of Electrical Engineers, in discussing the case, points out that the vibration problem, which has come with large reaction units under high heads, has not been thoroughly understood, and states: "In cases where vibration occurred a cut-and-try system of remedying it was usually resorted to and as little publicity as possible given to the procedure." This is all too true. If aversion to publicity is allowed to prevent placing discoveries on record, progress toward a solution of difficulties is hindered. In this instance particularly it is of great importance that the profession have the benefit of what has been learned. The facts brought out in finding a solution for the trouble in this case have thrown new light on the necessity for avoiding certain relations or combinations in designing reaction runners and guide vanes. Also there was developed a method of measuring and studying vibration in large units on a comparative basis that will be of great value in making similar studies elsewhere.

The vibration of reaction wheels has not been sufficiently well understood. In some plants where it has occurred there has been resort to struts and mass concrete to brace and weight the unit to absorb the vibration. As individual units have been made larger and put under higher heads the problem has grown more serious and the time has now come when it must be reckoned with in design. Although some manufacturers have doubtless had a sufficient knowledge of the proper proportions and relations of certain parts of the unit to keep within safe limits, nevertheless the causes of vibration have not yet been analyzed to such an extent that they can be expressed by exact formulas. Much more study on the subject is necessary. Fortunately, and as a result of the incident already referred to, there has been developed what seems to be an excellent means of making accurate studies of turbine vibrations. This deserves the careful attention of other company engineers wherever large reaction wheels are used. The power company is the logical agent for conducting studies that deal with operating conditions; the power company has the men and the equipment at the plant and no one else has so much at stake.

The development of the large-size, high-head reaction wheel made it imperative that vibration be controlled. Nothing is to be gained by glossing over previous difficulties or attempting to evade the issue. As the result of the case described in this issue it is safe to say the power company concerned will go thoroughly into the question of possible vibration in planning for future units. There is therefore an object lesson in this incident—now that the importance of keeping vibration down to a minimum is understood and since it is believed that this can be accomplished by proper design, there will henceforth be no excuse for failing to take vibration into account.

The "Modern" Highway System

EXAMINATION of the annual report of the Wayne County, Michigan, road commissioners always gives one an interesting hour, if for nothing more than to show the forward steps of an organization that for the past seventeen years has been proceeding on a consistent program of highway development. When we think of highways, our thought is chiefly of the road surfacing. Looked at from this point of view, the most spectacular part of the paving work of Wayne County is drawing to a close. Its concrete highway system, laid out to cover 25 per cent of the county's mileage, will, after the prosecution of a persistent program since 1906, be brought to a conclusion by the 1924 work. Of course, grading and improvement of the secondary road system will still go on for some years.

But does that mean that the Wayne County highway system is "complete"?

The recent report of the road commissioners answers that question, for the greater part of the report is not taken up with paving, but rather with bridge building, grade separation, and with such roadside developments as tree planting, tree trimming, the improvement of road intersections, the sodding of embankments, the disposition of the wires of the public utility companies, the placing of highway signs, and the improvement of the large natural parks which are co-ordinated with the highway system. In other words, though every square yard of hard surface paving planned for the county should be completed and though the surfacing of the secondary roads should be done, there is still work, much work, ahead of the road commissioners. Edward N. Hines, chairman of the commission, asked recently when its job would be done, gave this reply:

"It will not be done until every mile of road in the county is improved; until every bridge is made safe and adequate in width; until pedestrian paths are provided on the trunk lines; until all grades are separated; until the system is lighted; until all the ditches are closed; until public comfort stations are provided to take care of the traveling public in a sanitary way; until all of our roads are planted; until we have numerous public parks and playgrounds; until all poles are off the highways and all wires are underground."

He added, significantly, "A big contract, but we have made a start on all of these projects, all of which are a necessary part of our ideal of what constitutes a modern highway transportation system."

All counties and states are not ready to accept this broad definition of what constitutes a modern highway transportation system. As a people we have not dared to visualize the full meaning of complete road service. Indeed, there is too much to be done to get the elements of a system of improved roads to have warranted most of us in reaching ahead much further than is necessary to secure graded and drained roadbed and adequately paved surfaces. Meanwhile we need prophets and leaders in the great enterprise of road building and we have them in the Wayne County Highway Commissioners and their far-seeing chairman.

Reconstruction of Sixteenth Street Viaduct in Denver

Combination Steel and Reinforced-Concrete Structure Designed So As to Utilize Existing Portions and Salvage Old Steel

By Elsie Eaves
Civil Engineer, Secretary to Herbert S. Crocker, Consulting Engineer, Denver, Colo.

SEVEN participants, five railroads, the street railway and the City and County of Denver, are paying jointly for the reconstruction, widening and straightening of the 34-year-old Sixteenth St. Viaduct in Denver, crossing the Platte River and numerous railroad tracks and carrying a heavy burden of street railway and vehicular traffic. Both design and construction features, particularly the sequence of carrying out the work, have been controlled by the number of organizations interested, their financial ability (two being in the hands of a receiver) and also by their operating requirements. Column bent spacing was fixed by existing track alignment and the desire to re-use certain steel girders. Concrete girders were designed so as to utilize the old steel for reinforcing after thorough cleaning. Additional steel reinforcing columns and trusses were jacked up under a new heavy concrete deck to insure their taking proportionate load.

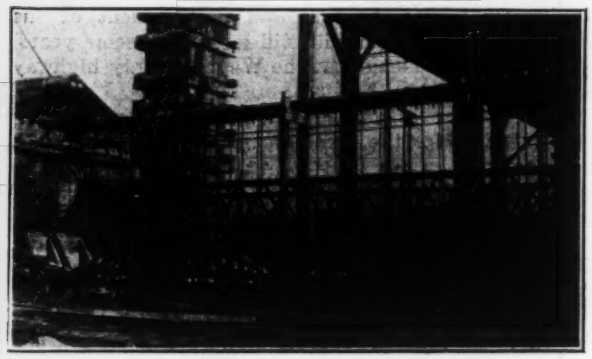


FIG. 1—CROSS-GIRDER REINFORCEMENT ASSEMBLED ON GROUND

Old hand-railing used as reinforcing is in position at the bottom of the assembled steel.

In 1889 the Denver City Cable Railway Co. constructed a 3,000-ft. steel viaduct, 34 ft. wide, on masonry footings across the Platte River and the railway tracks. In 1910 two bad grades at the north end were removed by extending the approach one block. In 1916, when the Denver Union Station was remodeled, the portion of the viaduct over the terminal tracks was rebuilt with four new through girder spans. This viaduct has been closed to vehicular traffic for some years but has been retained for street railway service. In 1921, however, its reconstruction became necessary to provide adequate connection with north Denver.

The Denver practice of financing structures of this kind is to apportion the cost by agreement among the utilities served. The railroads proposed to reinforce the old bridge and build a fireproof deck. At the same time the City and County of Denver presented an alternative plan for rebuilding in concrete, utilizing some 75 per cent of the steel of the old structure. As the railroad estimate did not provide new foundations, and as records were not available to determine the condition of the substructure of the old bridge, it was decided to adopt the city plan. The amount each participant should contribute was based upon the proportion of its frontage on the viaduct right-of-way and upon its traffic served. Since the Denver Tramway Co. and the Denver & Salt Lake R. R. were in the hands of receivers it was impossible for them to contribute their share of cash, but the city agreed to handle the Denver & Salt Lake R. R. share and permitted the Tramway Co. to provide equipment, yard facilities and labor in lieu of money.

The design was separated into five broad divisions: (1) new pedestal foundations, U-wall abutments and concrete river piers; (2) removal of the two deck-truss river spans and the substitution of two skew, four-rib, spandrel-column, concrete arch spans; (3) dismantling and remodeling of the steel in the original structure built in 1889 and the design of a concrete structure enveloping the re-used steel; (4) widening the old part to a 44-ft. roadway to correspond with the remainder of the new structure, strengthening, elevating to grade and remodeling without dismantling of the steel portion at the north end which was built in 1910 and (5) the

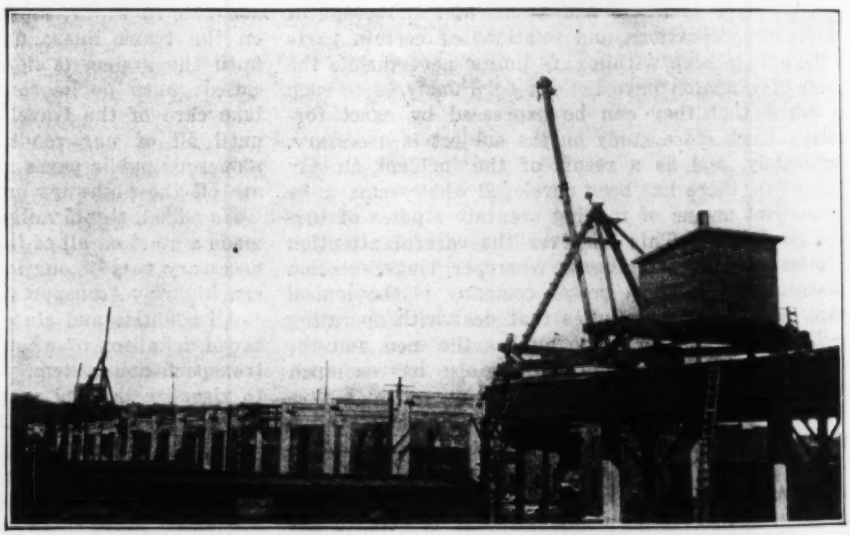


FIG. 2—TRAVELERS REMOVING OLD STEEL AND REPLACING NEW

Traveler 1 at right moving backward on old structure removes steel behind it. No. 2 at left is ready to erect steel stringers on concrete bents constructed by the Tramway Co.

FIG. 3—TRAMWAY MIXER TRAIN ON TOP OF VIADUCT

Electrically-operated 10-ft. mixer attended by flat car equipped with batch cars in position to load mixer. Motor car used for switching is next in the train. In the background is the tower of the city's mixing plant. The mixer train is on the construction track and at the left is the operating track for outbound traffic, both supported by the steel girders on concrete bents of the center portion of the viaduct. As soon as the outside portion on the right is finished the tracks will be interchanged and the outside portion on the left will be built.

widening, strengthening and remodeling without dismantling of the "Terminal Section."

As the first and second groups were of new construction they presented no unusual difficulties. In the third group the old steel girders and transverse floor beams were used as stringers under the street railway tracks in the new design, so that the span lengths were fixed by the steel lengths available. This portion of the viaduct crossed railroad yards where the track alignment was fixed and clearances were secured without yard changes. The construction in this group was entirely of concrete, except for the steel stringers under the tracks, a continuous girder design being used, with sections of from three to five spans between expansion joints of the split-bent type.

To enable the Denver Tramway Co. to operate cars over the viaduct before the entire structure was completed, the plan contemplated the construction first of the center portion carrying the track. The old hand-railing was used as reinforcement in the concrete cross-girders and old 48-lb. rails in the columns. While the weight was more than required, and the handling costs were greater, the low first cost made the use of this second-hand material attractive.

Jack Steel to Bear Load—In the fourth and fifth groups the new concrete decking and the heavier wheel loads made necessary steel columns and trusses to reinforce the existing structure. The problem of insuring that these new members carry their proportionate share of the load led to the plan of placing the center columns with a driving fit, pouring the superstructure, then jacking up the trusses under the load. By means of deflections, the amount each truss should be jacked up was found to vary from $\frac{1}{8}$ to $\frac{3}{8}$ in., depending upon its length. The entire steel structure in the fourth group was jacked up from 0 to 10 in. to bring it to the new grade.

Construction and Progress—On Nov. 14, 1922, the Denver Wrecking Co. began removing the timber decking, closely followed by the Denver Tramway Co. removing the flooring between its tracks. The foundation contractor also began excavation. As the city planned to dismantle, remodel and re-erect the steel on force account under the engineer's direction, a city steel gang followed the floor wreckers, burning off rivets, backing them out and bolting the steel ready for removal. In view of the low salvage value of the 105-ft. deck trusses on the two river spans, their floor beams were removed, anchors loosened and struts and lateral bracing cut, so that by throwing a line over the top chord of the far truss and using a stiff-leg derrick to pull the span over sideways, the steel was dropped into the river bed, where it was cut into carload lengths and snaked out to be sold as scrap.

A network of water pipes, gas pipes and telegraph cables as well as many old, unused and broken lines was encountered by the foundation contractor. In many cases the design of special footings was necessary, and for several blocks the south pedestal footings and U-wall abutment footings had to be carried down 16 ft. to avoid a 4-ft. sewer. At the river several hundred feet of 24-in. water main had to be moved out of the way of the new foundations by the water department's forces.

Street Railway "Works Out" Its Share—The Denver Tramway Co. "worked out" its share of the cost of building and setting the forms, placing the reinforcing steel and mixing and placing the concrete for the center

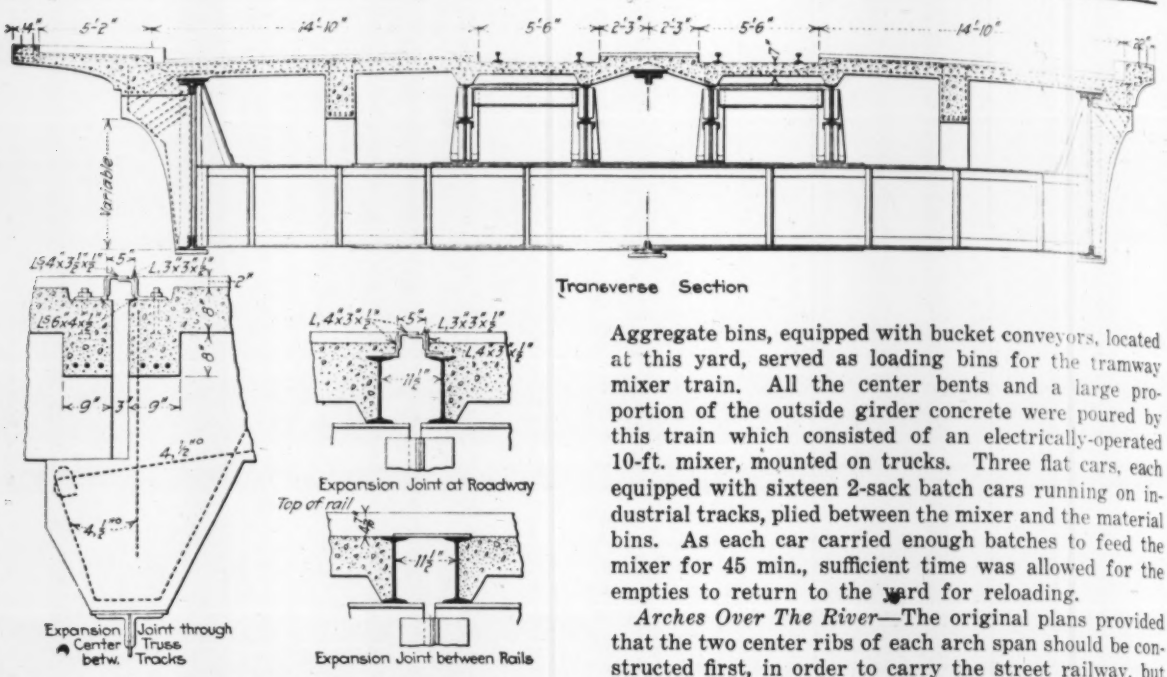


FIG. 5—FLOOR AND EXPANSION JOINTS AT "TERMINAL SECTION"
Concrete supplements structural steel in existing structure.

bents which were to support the steel girders under the street railway tracks. It was in this section that the second-hand rail and the old hand-railing were used for reinforcement. The old steel was cleaned of rust and adhering concrete by pneumatic tools and generous applications of caustic soda solution.

Work was begun at the river and pushed toward the south end. The foundation contractor concreted the pedestals, closely followed by the Tramway Co. gang putting up reinforcing steel, setting forms and pouring column bases, moving along the ground a small electrically-driven mixer as the work progressed. A construction track on the old steel structure yet standing served for the concrete train and other special equipment. The bents were poured from above by means of this train. Both sides of the split bents were poured at the same time, this operation being made possible by use of a metal-covered diaphragm fitted with straps which was pulled out from the top as steel was erected.

Waiting only for the Tramway Co. to get well started on the concreting, traveler 1, on the river end of the steel work, picked up the old steel and loaded it on trucks for removal to a yard where it was cleaned with caustic soda solution and wire brushes and then remodeled. Traveler 1 waited until the first four remodeled girders were returned to the first span, where it erected them before removing more steel and progressing toward the south end. Traveler 2 was then erected on the first span. In operation, traveler 1, running on the old steel structure, dismantled the bridge behind it. Motor trucks carried the old steel to the reframing yard and returned with the fabricated material which traveler 2, running on the newly placed steel, erected on the new concrete bents.

Removal of the light steel members was done by a small crane car operating over the tramway tracks on the viaduct. In the reframing yard, the heavy steel members were handled by a 5-ton steel guy derrick. Aggregate bins, equipped with bucket conveyors, located at this yard, served as loading bins for the tramway mixer train. All the center bents and a large proportion of the outside girder concrete were poured by this train which consisted of an electrically-operated 10-ft. mixer, mounted on trucks. Three flat cars, each equipped with sixteen 2-sack batch cars running on industrial tracks, plied between the mixer and the material bins. As each car carried enough batches to feed the mixer for 45 min., sufficient time was allowed for the empties to return to the yard for reloading.

Arches Over The River—The original plans provided that the two center ribs of each arch span should be constructed first, in order to carry the street railway, but as the contract was not awarded in time to carry out this program a temporary trestle was erected to serve the purpose. Temporary piling supported both the trestle and the arch centering. The four center ribs were concreted first on piers constructed by the foundation contractor. When, fifteen days after pouring, the wedges were struck, it was found that those under the center of the span were loose. The slight deformation of the falsework causing this condition may have been due to the method of placing concrete first at the skewbacks and pouring symmetrically about the vertical axis of the arch until the final concrete was placed at the crown. Levels taken before and after striking the wedges showed that the removal of the centers had little effect on the arch.

Instead of building haunches on the ribs to serve as seats for the spandrel columns, steel rods projected from the ribs to tie on the spandrel column reinforcement, and the surface of the rib was roughened to provide a good bond with the column concrete. This method gave a joint of excellent appearance. Spandrel columns and decking were poured after the centering of the arches had been struck.

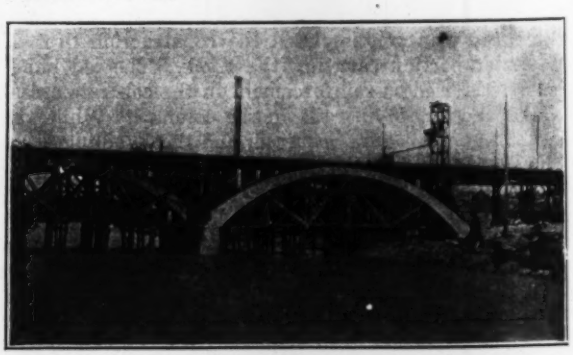


FIG. 4—TWO ARCHES SPAN THE PLATTE RIVER
The center ribs of both spans and the downstream rib of the north arch have been built. The spandrel columns on the center ribs of the north (right) span and the decking have been poured and stripped of forms while the columns and decking of the center of the south span are being poured.

The contractor's plant consisted of one mixer and one tower, the concrete being carted to alternate ends of the arch to secure the balanced pouring.

Widening—After contracts for the foundations and for the arch spans were let, there remained the building of the two outside portions of the main structure and the placing of the concrete decking on the north end section and the "Terminal" section. As the Denver Tramway Co. wished to place the concrete in the remainder of the viaduct, the city contracted for sand and gravel, made complete form drawings and contracted with a local milling company for the construction of forms ready to be set up. Cement was bought by the city for the entire job to insure proper proportioning.

Compressive Tests of Hollow-Tile Walls

AS A RESULT of some tests of hollow-tile walls, 6, 8 and 12 in. thick, 4 ft. long by 12 ft. high, tested for compression, the United States Bureau of Standards presents the following conclusions: (1) Walls built of high strength tile were set with great care by an experienced mason. They were undoubtedly much stronger than walls built under ordinary commercial conditions. (2) Great differences in strength of tile do not appear to have appreciable effects on the strength of the wall. (3) Stress failure of the thin walls was about the same as for the thick walls, showing there was no appreciable column action. (4) No relation was found between the ultimate strength and the load at first crack. (5) Stress at failure, computed on the net sectional area, was remarkably constant with tile on end, being independent of the size of the tile. (6) Walls having the cells of the tile vertical had on the average more than twice the strength of those having the cells horizontal. (7) Walls loaded with an eccentricity of 2 in. over one-half the width of the wall had about one-half the strength of similar walls axially loaded. Apparently this ratio is independent of the thickness of the walls. (8) Excessively loaded walls failed by crushing of the tile under the bearing plate. (9) Due to the wide differences in the modulus of elasticity of the tile, strain-gage readings were of little use. In general the deformation across a joint was much greater than the adjacent tile, in many cases being twice as great. (10) No relation could be found between the modulus of elasticity for the wall and that for the tile.

The above information is contained in the United States Bureau of Standards Technologic Paper No. 338, this report having been prepared by H. L. Whittemore of the Division of Metals and Bernard D. Hathcock.

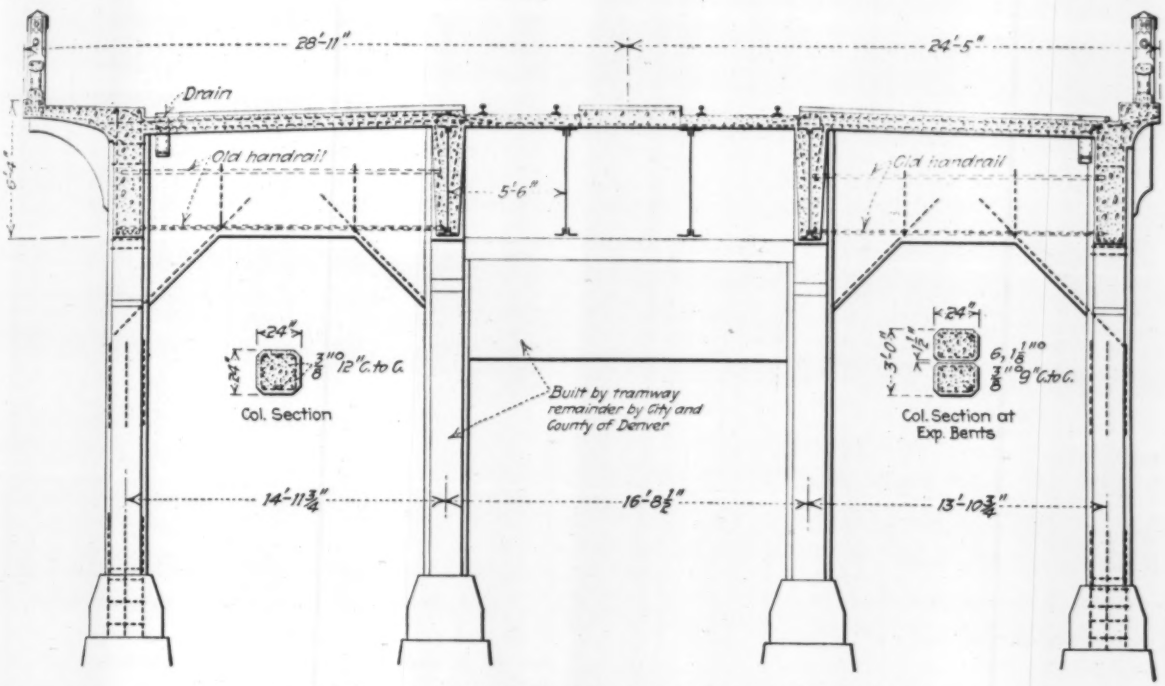


FIG. 6—TYPICAL SECTION OF ALL-CONCRETE REPLACEMENT

A tramway flat car was converted into a light derrick car, with which column reinforcing cages and column forms (assembled on the ground) were lifted into place and reinforcing steel and forms were handled. The girder sections between expansion joints, amounting to as much as 264 cu.yd., had to be poured continuously. To expedite the work, the tramway concrete train was supplemented by a tower, the train on the bridge competing with the mixer and tower on the ground to see which could place concrete the more economically. The split-bent expansion joints in this section were not so easily constructed as in the center portion; each half was formed and poured separately.

The engineer for the city on this work, which it is hoped will be completed early in 1924, is Herbert S. Crocker. Heading his designing staff is Ira O. Thorley who worked out the details of the plan of remodeling and who proposed and designed the continuous girders and split-bent joints. John S. Means is resident engineer in charge of the field work. Frank B. Varnum, who built the foundations, and the C. S. Lambie Co., which subcontracted the arch spans to Rodgers & Pickard, were the only contractors.

An Experiment in Earth Road Construction

Highway Extension Work by Purdue University Teaches Back-District Farmers Good Road Methods

By Ben H. Petty
Assistant Professor of Highway Engineering, Purdue University, Lafayette, Ind.

A UNIQUE experiment in highway extension work was made by Purdue University during the past summer in the southern part of Indiana. In the winter of 1921-22 the Agricultural Extension Department conducted a very complete survey of agricultural conditions in six counties of this end of the state. Some astonishing conditions were revealed. One was that very little can be done to improve the backward farming situation until an adequate system of roads is constructed to provide the farmers an all-year outlet to their produce market.

An improved road is a curiosity in many parts of this district. The writer has traversed so-called roads which ran for long distances in the beds of streams.

STARTING IMPROVEMENT ON EVANSTON-TROY ROAD

EVANSTON-TROY ROAD AFTER IMPROVEMENT

In many places outcrops of ledge rock make a series of steps on hills that are practically unsurmountable for automobiles. During a rain the earth roads are converted into mud holes which practically eliminate traffic until they are dried out. In winter there is apparently no bottom to the roads, it being impossible to traverse some of them even on horseback.

There are some improved roads of stone or gravel leading out of the larger towns for various distances, most of them extending only a few miles. More roads are being improved each year but it will be many years before this improvement can be extended adequately to serve the entire district. Due in large measure to the fact that road conditions are so poor, this district has not been developed to its possibilities. Therefore the property valuation is low and very little revenue is produced through taxes for road development. Hundreds of acres appear on the tax duplicate as $10 per acre and some as low as $3. This of course is in the more inaccessible sections; some parts are well developed and contain very valuable farm land.

The present conditions simply mean that the farmer who is not fortunate enough to be located along one of the few improved roads is isolated for several weeks or months of the year. The survey showed that some roads were impassable as many as six to eight months.

In endeavoring to relieve this situation an agreement was worked out between the Highway Engineering and Agricultural Extension Departments of Purdue University and the State Highway Commission whereby an engineer could be sent into this district to spend the summer in directing the construction of demonstration sections of earth roads. The arrangements were perfected in June, 1922, by W. Q. Fitch of the Agricultual Extension Department and the writer in co-operation with the local county agricultural agents in the six counties. These plans provided for the construction of short standard sections of earth road in each county by the aid of volunteer labor on the part of the interested farmers. The short sections were to serve as models to guide the farmers in extending the improvement.

During June two trips were made into the district and in company with the local county agricultural agents inspections were made of various proposed sites for demonstration work. Suitable stretches of road, varying from ½ mile to 2½ miles in length, were selected in each county where definite assurance of co-operation could be secured from the local farmers. The kind and quantity of necessary equipment available locally was ascertained and a tentative date for commencing work was set conforming as nearly as possible to the desires of the interested farmers who were to do the work.

Under the leadership of the county agents, road booster meetings were held in these various localities, organizations were perfected and definite plans of procedure were worked out. Men living in the vicinity of the sections selected for improvement were interviewed by committees and their pledges secured to donate a certain number of days' work with teams or as single hands.

As an indication of the interest aroused, the case of the Rome-Derby Road in Perry County may be cited. To straighten and improve a half-mile stretch of earth road with a gravel surface, those interested pledged a total of $1,300 to be paid either in cash or in work on the basis of $1.50 per day for single hands and $3 per day for teams. A large amount was pledged in Derby seven miles away. On only one other section were cash donations solicited, that being the Zoar road in Dubois County. About $400 was secured mostly from Huntingburg merchants four or five miles away from the half-mile section being improved.

Professor R. B. Wiley, acting head of the school of Civil Engineering, arranged with J. D. Williams, director of the State Highway Department, for co-operation in the way of needed equipment in those districts where local equipment was insufficient or

lacking altogether. This co-operation aided materially in the successful prosecution of the work. The county highway superintendents and, in most cases, the township trustees co-operated splendidly.

The roads selected for improvement were all township roads in very bad condition. Practically all of the roads in this district are too narrow. The demonstration sections of earth road were built to a width of 20 ft. between shoulders, conforming with the standard county road width. On some of the roads there were no culverts at all and storm water had an unrestricted sweep across the roadway. Where culverts existed they were invariably too short, averaging about 12 ft. in length, thereby limiting traffic to a single track. On the improved sections the culverts were lengthened to the full width of the roadway.

In Indiana the township roads are under the supervision of the township trustees. The funds available for road work in the poorer townships are very limited, in many cases averaging as low as $20 per mile per year. This accounts for the neglect of the roads in many localities.

The accompanying table gives the results of the summer's work. The total cost is based on the assumption that the volunteer labor was paid for at prevailing rates. The cost of engineering supervision is not included. The writer spent from one week to ten days in each county directing the work.

COST OF EXPERIMENTAL ROAD IMPROVEMENT, SOUTHERN INDIANA

County	Road	Length in Miles	Days of Labor: Hand	Days of Labor: Team	Material Purchased	Days for Tractive Power	Total Cost
Crawford	Grantsburg-West Fork	½	25@ $2.00	6@ $4.00	*Dynamite $6.00	.....	$80.00
	Riceville-Wicliffe	½	49@ $2.00	15@ $4.00	*Dynamite $5.00	4@ $15.00[1]	223.00
DuBois	Huntingburg-Zoar	½	107@ $2.50	103@ $4.00	Miscl. $164.00	.....	847.50
	Jasper-Ireland	1	72@ $2.50	53@ $4.00	Oil on road $1,045.00	.....	1,437.00
Spencer	Evanston-Troy	½	77@ $2.00	78@ $4.00	* Miscl. $10.00	1@ $15.00[1]	491.00
	Dale-Stendale	2	*30@ $2.00	*10@ $4.00	Miscl.[4] $65.00	41@ $50.00[2]	215.00
Warrick	Elberfeld-Millersburg	1	6@ $2.00	12@ $4.00	*Culverts $50.00	3@ $20.00[3]	170.00
Perry	Rome-Derby	½	174@ $1.50	119@ $3.00	Dynamite $17.75	.....	647.00
Pike	Petersburg-Oatsville	1	*10@ $2.50	*10@ $4.00	.....	4@ $33.00[2]	197.00

* Estimated. [1] Traction Engine. [2] Tractor [3] Truck. [4] 40 gal. gasoline @25c. = $10.00, 1,000 ft. bridge lumber $30.00, 100 lb. dynamite $25.00.

Conclusion—The summer's work as a whole was highly successful. The improvements received considerable publicity in the local papers and the position of Purdue University and the State Highway Commission was greatly strengthened in this district. The farmers have been shown what can be accomplished in standard earth road improvement with meager equipment and at very low actual cost. Undoubtedly these demonstration roads will stimulate similar improvements in these counties. The farmers have been taught to help themselves in the matter of road improvement and this is exactly what they will have to do to get better roads until such a time as revenue from taxation provides sufficient funds to finance such improvements.

To Investigate Arch Dams

ENGINEERING FOUNDATION'S committee on arch dam investigation has recently submitted a progress report. Two meetings were held in San Francisco, in the early part of the year, and a tentative program was formulated. The committee was fortunate enough to secure for the proposed investigation of arch and multiple-arch dams the active co-operation of the following parties who own or control dams: United States Reclamation Service; State of California; City of San Francisco; Pacific Gas and Electric Co., San Francisco; and Southern California Edison Co., Los Angeles. Furthermore the officials of the University of California, Stanford University, and Massachusetts Institute of Technology have offered the use of their testing laboratories and have assured the committee of other co-operation.

A search was first made for types of instruments which would be suitable for the proposed investigation. Some of the instruments required were readily obtainable in the open market, and others were ordered from manufacturers according to specially prepared drawings and specifications. The owners of dams co-operating actively with your committee agreed to furnish all the necessary instruments and to bear all the expenses incidental to a complete investigation of their dams in accordance with the program.

Dams Selected—In view of the considerable expenses involved in making continuous and accurate measurements on suitable structures, most of which are located far up in the mountains, it was decided to start on a somewhat limited scale and to include during the first season of field observations only structures for which the conditions for making measurements appeared to be particularly favorable. Consequently, the following dams were selected for the first part of the investigation: Hubbart Dam, Mont. (under construction); Clear Creek Dam, Yakima Project (both dams built by the U. S. Reclamation Service); Dam No. 6 of Southern California Edison Co.; Lake Spaulding Dam, Pacific Gas and Electric Co.; Lake Eleanor Multiple-Arch Dam, San Francisco; and the Lake Hodges Multiple Arch Dam, California.

The tests on each dam were placed in the immediate charge of a sub-committee of engineers who are particularly familiar with that dam. In order to coordinate the work on all dams local members of the main committee are acting as chairmen of the subcommittees.

Preliminary steps were taken for having laboratory tests made on models. Furthermore, several power companies have expressed willingness to consider financing the construction of a specially designed test dam, which could be tested repeatedly and finally loaded to destruction.

Professor C. Derleth, Jr., of the University of California, is chairman of the committee, and Fred A. Noetzli, Los Angeles, is secretary. Other members are H. Hawgood, D. C. Henny, W. F. McClure, M. M. O'Shaughnessy, H. Hobart Porter, F. E. Weymouth, Silas H. Woodard, Paul Bailey, R. P. McIntosh, and Wynn Meredith. The committee will be glad to receive information about interesting arch and multiple-arch dams and suggestions that will be helpful in its investigations. Several engineers in America and Europe have co-operated in this way.

Federal Land Reclamation: A National Problem

3. Agriculture on Irrigated Lands.

The Third of a Series of Articles on the History and Performance of the Great Government Adventure in Irrigation of the Arid Land of the West.

By CARL S. SCOFIELD
Agriculturist, U. S. Department of Agriculture

IN UNDERTAKING the utilization of the arid lands of the western United States through irrigation, conditions and problems have been encountered that are new to our race. Our agricultural people have been since the beginning of civilization accustomed to farming under rainfall. The engineers who have planned and built our irrigation works have had to meet and solve many new problems not only in connection with the construction work but more particularly in the continued profitable use of the water in agriculture. Irrigation farming may be older than any other kind of highly developed agriculture but the people of northern Europe who have contributed so largely to our population and occupied our agricultural lands have had no practical experience with irrigation. The engineers who constructed and operated the extensive irrigation works of antiquity in Western Asia and Northern Africa have left no written accounts of their work, and the problems and difficulties of the men who farmed those irrigated lands have not been recorded. There are evidences that irrigation was used both in North America and in South America long before the arrival of Columbus. In Peru and along the Gila and the Santa Cruz in Arizona, the discoverers found irrigation in use to a limited extent and it is now known that there were much more extensive irrigated areas that had long since been abandoned, as for example in the Salt River Valley of Arizona.

With us the development of irrigation farming has been for purposes of homemaking rather than to contribute directly to the volume of our agricultural products. In the valleys of Utah and in the foothills of California where irrigation was first undertaken about the middle of the last century, it was used to support pioneer communities. Later, extensions were made chiefly to provide support for families or communities largely engaged in other enterprises such as mining, stock raising, dry farming, or lumbering. It is only in recent years and to a limited extent that our irrigated lands have begun to produce commodities beyond the requirements of the immediate neighborhood and these commodities are chiefly specialties such a citrus and deciduous fruits, certain off-season truck crops, dairy products and long-staple cotton. The chief purpose that these lands have served is to support other industries and to make possible the effective utilization of adjacent dry lands.

The western half of the United States which includes practically all of our irrigated land is the great livestock breeding ground for the country. On its broad prairies and in the mountain parks and valleys our sheep and cattle are born and reared. Each year the wool goes East to market and the lambs and steers move into the corn belt to be fattened. The breeding herds and flocks stay on the ranges. But this western country is subject to great vicissitudes of climate, to prolonged droughts and to winter storms. These take enormous toll from the breeding stock on the open range. A series of hard years such as recur almost every decade might sweep these ranges clean if it were not for those scattered valleys in which irrigation has made it possible to produce the feed and provide the shelter to carry the breeding stock through.

On the western Great Plains, on the high benches of the Great Basin, and in the broad valleys of the Snake River and the Columbia lie millions of acres of fertile land. This is the region to which we look for our great supplies of wheat. It was in this region that we produced the "food that won the war." But the rainfall that makes this production possible is extremely irregular. The only regular thing about it is that good seasons are followed by bad seasons. If the land is to be utilized in the good seasons there must be farmers on hand or nearby with work-stock and equipment to put in and harvest the crops. Or to put it another way, the stability of dry farming in the West depends upon the maintenance throughout the dry lands of irrigated sections to which the farmers may retreat and find support for themselves and their stock during the drier years. It is in these irrigated areas, small and scattered though they are, that we have some measure of insurance against the losses that would otherwise be disastrous to our national supply of meat and bread.

Development of Irrigation Projects

The first irrigation projects were small undertakings designed and constructed by individuals or by local co-operation, as by the pioneers of Utah. The investment of capital was small and soon liquidated. Later it became necessary to cope with larger engineering problems, to adjudicate and validate water rights and to undertake work that required large capital investments. This step involved the recognition that the irrigation works together with the lands they served with water should become security for the capital invested in construction. To be good security the lands must be productive, must be able to support a prosperous agriculture. For the larger projects which required expensive works for the storage, diversion and distribution of water, the money investment came to be a most important consideration. To repay this investment from the earnings of the land requires a long period of liquidation during which the agriculture must continue to be prosperous.

This situation has made it essential that in projecting a large irrigation enterprise the promoter or the engineer must take into account not only what it will cost to construct the works but also the character of the land to be served with the water, the quality of the water with respect to its dissolved salts, the character of the farmers who are to use the land and the water, and finally, those complex relationships of agriculture and economics which have to do with crop production and marketing.

The development of a successful irrigation project involves at least three different classes of problems, viz., legal, engineering, and agricultural. The last named group may be made to include not only the possibilities and limitations of crop production but also those matters that have to do with the settlement of the land, the type of farming, and crop utilization. The present paper deals with these agricultural problems.

The Land and the Water

It is an outstanding characteristic of our arid lands susceptible of irrigation that within a restricted area they are more variable in character and in potential productivity than the lands of humid regions.

This fact is due to the nature of their origin and formation. For the most part these irrigable lands have been made along river channels or delta cones. The soil deposited by flood waters may vary from gravel to clay within a few feet either laterally or vertically. Even where the surface topography is uniform the surface soil may vary in texture and depth between wide limits. It is generally true that the area of irrigable land in any project exceeds the available supply of water so that there is opportunity to select only the better lands for irrigation. There is often a strong temptation to the engineer who locates the distribution system to select compact and accessible units of land even though these may include soil areas of doubtful value as has been done for example on the Huntley, Shoshone, and Yuma Projects. The initial construction cost per acre of land served may be less if the water is distributed to the most accessible land, but when it comes to repaying these construction costs it becomes evident that productivity and not accessibility is the safer criterion for selecting land irrigation. The irrigation engineers of North Africa have found after years of bitter experience that their real problem is first to locate areas of good land in the desert and then conduct the water often long distances to reach that land.

Surface Topography—In selecting land for irrigation, a number of factors must be kept in mind. The surface topography must be such that the cost of leveling for irrigation is not prohibitive. Labor or money invested in preparing land for irrigation is just as definitely a capital investment as though it were invested in works for the storage or distribution of water. It sometimes costs as much as $100 per acre to level land for irrigation though such cases are exceptional. But there are large units of land put under ditch where the cost of leveling is as much as $35 to $40 per acre. Land with a good surface topography may be leveled for $5 to $10 per acre. The cost of leveling the land may be actually greater than the cost of the water yet too often it is not taken into account in advance as one of the factors to be considered in selecting land for irrigation.

Texture and Depth of Soil—The texture and depth of the soil is no less important than the surface topography. If a soil is to be continuously productive under irrigation its texture must be such that part of the water applied may percolate downward past the root zone to carry away any excess of dissolved salts that would otherwise accumulate by the evaporation of the water from the soil or transpiration from growing plants. On the other hand, the chief function of the soil is to serve as a reservoir in which water may be stored for use by plants from one irrigation to the next. To do this effectively the soil must be not only permeable to water so as to absorb water readily when irrigated but it should be deep enough and fine enough to hold several inches of available water within the root zone. Coarse sandy soils or a thin layer of good soil over a sand of gravel subsoil cannot hold a sufficient quantity of available water to provide the growing crop with a uniform supply.

Movement of Water at Roots—The third important factor of irrigated land has to do with the movement of water below the root zone. If the productivity of irrigated land is to be maintained there must be some percolation through the root zone in every part of the irrigated area. Unless such percolation occurs the dissolved salt brought into the soil by the irrigation water must in time accumulate in toxic quantities. In the ordinary course of irrigation, part of the water applied, and often too large a part, percolates through the root zone in the more permeable spots. Such excessive percolation is of no advantage but often quite the reverse. The aim of efficient irrigation is to distribute the water to the land in such a way and in such quantities that there may be some percolation through the root zone everywhere. In this way the excess of dissolved salts may be removed and an undue waste of water avoided. In any event conditions below the root zone must be such that the percolating water may be removed as drainage. Where such conditions do not exist naturally it must be possible to establish them artificially if the land is to continue productive.

The three essential features of irrigated land may be summarized as follows: The surface topography must be such as not to involve excessive cost for leveling; the texture of the soil must be such that it is permeable to water and sufficiently deep and retentive to hold several inches of available water within the root zone; and the subsoil conditions must be such as to permit the escape of water that percolates through the root zone.

Characteristics of Water—With respect to the character of the water, the essential requirements may also be stated simply. All irrigation water carries some dissolved material. The quantity may be small, as low as 100 parts per million, or it may be large, as high as 5,000 parts per million. In dealing with these proportions it may be kept in mind that an acre-foot of water weighs about 2.7 million pounds. The water that is applied to the land in irrigation is used or lost in three ways. It is evaporated from the soil, it is absorbed and transpired by plants, or it percolates through the root zone into the country drainage.

That part of it that is lost by direct evaporation leaves all of its dissolved salts in the soil, the part that is absorbed by plants leaves nearly all of its dissolved salts behind. It is only the water that percolates below the root zone that carries salt away. In this fact lies the significance of insuring that some water shall percolate downward through every part of the soil.

Owing to the fact that a large part of the water applied as irrigation is evaporated into the air either directly from the soil or from the leaves of plants, the soil solution is invariably more concentrated than the irrigation water. It is not uncommon to find that the soil solution in irrigated land contains as much as 5,000 parts or even 10,000 parts per million of dissolved material. This is a very different situation than exists in soils that are watered by rain or melted snow and

watered sufficiently to be leached frequently if not continuously. In such soils the solution contains from 100 to 1,000 parts per million of dissolved salts. When plant roots absorb water from the soil they do not take in the solution as it exists in the same way that a horse drinks water from a trough. They take the water from the solution and only such of the dissolved constituents as are needed for purposes of growth. As the soil solution becomes more concentrated it becomes increasingly difficult for the plant to absorb from it the water it needs. For most crop plants the limit of concentration of the soil solution is about 1.5 per cent or 15,000 parts per million. Crop plants differ somewhat in their limits of tolerance and they differ also as to the quantity of water they require. The average water requirement is probably not far from 400 pounds of water for each pound of dry matter produced.

The salts that are dissolved in the irrigation water or that exist in the soil solution have to be considered not only in relation to the crop plants but also in relation to the soil. The soil cannot be regarded merely as finely divided inert material in which the solution is held. It is an exceedingly complex system, some parts of which react chemically with the solution. As a result of these reactions certain constituents of the solution may combine with the soil and other constituents that were combined with the soil may pass into the solution. Such reactions are more pronounced when the solution is more concentrated. The results of these reactions between the solution and the soil may be manifested by pronounced changes in the physical condition of the soil as well as by changes in the chemical composition of the soil solution.

Permeability of Soil—The factor of physical condition that is most important in irrigated soils has to do with permeability to water. Permeability is directly influenced by certain of the reactions that take place between the soil and the soil solution. When a soil has been in contact with a concentrated solution in which the salts of calcium or magnesium predominate, the physical condition and permeability continue to be good if the concentration of the solution is reduced as by leaching with pure water. On the other hand, if the soil has been in contact with a concentrated solution in which the salts of sodium and potassium predominate the soil becomes puddled and its permeability is greatly reduced when the soil is leached with pure water. It has long been known that some irrigated lands become puddled or hard and impermeable to water. This condition has been thought to be due to action of the dreaded "black alkali," sodium carbonate. Recent investigations have shown that the soil may become puddled or impermeable from the action of sodium in the form of any salt. Even sodium nitrate has been shown to have the same effect as sodium carbonate. These facts make it important to take into account the character as well as the quantity of salts in irrigation water. Where the proportion of earthy bases in solution is less than the alkali bases, a condition that is almost certain to cause trouble, it is possible to change the balance of salts by treating the land or the water with gypsum.

There is ample evidence in our older irrigated areas of the significance of these differences in the quality of the water. There are extensive areas where through inadequate drainage the soil has become water-logged and salty and where complete and satisfactory reclamation has followed drainage. The Rio Grande and North Platte projects afford striking examples of such restoration. There are other areas as in the valley of the Great Salt Lake in Utah where the land that was once productive became water-logged after a few years of irrigation and has remained impermeable to water and consequently unproductive even though elaborate drainage systems have been installed.

It is generally assumed that the occurrence of alkali troubles in irrigated land is due solely to the excessive use of water or the lack of adequate drainage. As a matter of fact an irrigated soil may become water-logged and unfit for crop production without becoming salty, though instances of this condition are uncommon. But it is not uncommon to find instances as in Southern California where the soil becomes salty or impermeable and unproductive without becoming water-logged or showing need of drainage. The development of such conditions is likely to be associated with the sparing use of water containing less calcium than sodium in solution.

Water-Logging—Many of the first irrigation projects, especially those established 20 to 30 years ago, were put in without any thought of the need of drainage. Some of these early projects soon developed troubles from underground water. These troubles were generally ascribed to the excessive and reckless use of water by the farmers and drainage relief was first considered merely as an expensive alternative to the more economical and efficient use of water in irrigation. Our irrigation engineers have been slow in appreciating the fact that the salts brought into the soil by irrigation water must be carried downward by percolation and outward by drainage or the productivity of the land would inevitably be ruined. It is not so much that underground water causes a rise of alkali as that it prevents the leaching action of irrigation water that is necessary to keep the soil productive.

From this it may be inferred that the character of the water used in irrigation may be a matter of the greatest importance in determining the time that the land may continue to be productive. This is a matter of concern not only to the farmer on the land but also to the agency that provides money on long term credits either for the construction of the project or as loans for the development and equipment of the farms. Irrigation works are designed and built to last for many years. It is clearly the expectation that the agriculture that these works make possible shall be as enduring as the works themselves. Yet it has been the sad experience in many localities that after a few years of irrigation the land becomes unproductive and must be abandoned.

The factors of the character of the soil and quality of water that determine sustained productivity under irrigation are almost infinitely complex. Some progress has been made in recent years in understanding them but the work is only started. Twenty years ago there was very little agricultural information available to engineers concerning the potential productivity of irrigated land or the effect on the soil of the salts dissolved in irrigation water. Facts bearing on these subjects are being accumulated by agricultural investigators working for the federal government and the Western states. The importance of these investigations is coming to be appreciated not only by engineers but also by

financial men and economists who have to consider the advisability of financing the rehabilitation of existing projects or the construction of new ones.

Crops and Cropping Systems

Farmers on irrigated lands have a wide range of crops from which to select. Almost every crop known on the continental United States is grown to some extent under irrigation. About half our irrigated acreage is now devoted to forage crops of which alfalfa is by far the most important. One-fourth of the land is used for cereals. Something less than 10 per cent is devoted to fruit crops and the remainder is used for such crops as sugar beets, cotton and truck crops.

There appears to be rather more of a tendency toward crop specialization among farmers on irrigated land than elsewhere. This is particularly true with the growers of citrus and deciduous fruits, certain truck crops, and sugar beets. There are certain definite advantages to be obtained from specializing in one or in a limited number of crops and there are certain disadvantages also in this system of farming. The chief advantages are that the farmer who specializes on one or a very few crops needs less equipment than the one who grows many different crops. It is also possible for him to become expert in his work. He may learn how to get good yields and to control the insect pests and plant diseases of one crop while he could scarcely hope to do so for a large number of crops. The outstanding disadvantages are that a one-crop system of farming does not provide continuous productive employment throughout the year and, with some crops at least, better yields may be obtained from a system of rotation of crops.

It is seldom possible to determine in advance of experimentation what crops or what system of cropping is best adapted to a newly irrigated region. It may take several years for a group of farmers on a new project to find themselves and to learn the difficulties and the possibilities of a new region. Their first crops will naturally be alfalfa and grain. Then as they become acquainted with local conditions and accumulate knowledge through experience, they will work into specialties or adopt a system of diversified crops grown in rotation.

This has been the course of events on several of the older projects as for example the Salt River, Yuma, and Imperial Valley projects in the Southwest. It became apparent more than fifteen years ago that alfalfa and grain crops could not be expected to bring returns on these projects that would justify the cost of production and pay the long haul to distant markets. Furthermore there was need of a crop requiring summer cultivation in order to control the weeds that became serious in fields devoted continuously to alfalfa and grain. To meet this need experiments were made under the auspices of the federal Department of Agriculture with long-staple cotton. This crop yields a product that is relatively high priced and can bear the cost of transportation. Its use in rotation with grain and alfalfa affords an opportunity to clear the fields of weeds and the seed, of which it yields 2 to 3 pounds for each pound of lint, is a valuable by-product both as a source of oil and as a feed for live-stock.

The production of cotton is now well established on all the important irrigated lands in the Southwest from the Pecos Valley to the San Joaquin. Its successful establishment has involved the solution of a number of agricultural problems as well as the organization of the farmers for controlling supplies of planting seed, selling the crop, and financing its production. The returns from the crop have gone far toward making these projects prosperous and the incidental benefits, such as improved yields of other crops and community organization, have been well worth while.

Successful irrigation farming must involve relatively high returns from the land. The labor costs of production which include the distribution of water to the crops are higher than in ordinary farming. The fixed charges assessed for repaying the cost of constructing the irrigation works and for operating and maintaining them must be added to the ordinary fixed costs such as taxes and interest on investment. It is only by more intensive use of the land or by obtaining much larger yields that these added costs can be met if the products of irrigation farming are to compete in the same markets with the products of ordinary farming.

The working out of a system of farming best suited to an irrigation project is a problem which deserves co-operation between the engineering management, the bankers, and the farmers. Its successful solution is a matter of such great importance to the whole community that it merits the attention of the best intelligence the community possesses. It involves matters of crop production, of financing and of marketing. A compact, circumscribed community such as an irrigation project constitutes a definite social and economic unit like a large family. It may be in part self-sustaining but it requires many commodities it cannot or does not produce. In order to obtain these it must produce certain commodities for outside sale. What shall these be? How much of what is needed locally can be produced locally? Of the products that may be grown for outside disposal, which are best suited to the limitations of transportation? Such questions as these need to be clearly formulated and seriously considered, not only by the farmers themselves but by the whole community. In formulating these questions and in assembling the data needed for their consideration the engineer may render a very important service to the community. Such an undertaking calls for the clear and well-ordered thinking that characterizes the engineering type of mind.

Irrigation Farmers

It has been remarked above that there is a great diversity in the soil of an irrigated region. Such diversity is no less marked among the farmers. In any consideration of the factors that make for the success or failure of an irrigation project the character of the farmer must be taken into account. It is no less important than the character of the soil or of the water. When a new irrigation project is opened for settlement, people of all sorts and conditions flock in to take up the land. Some of them come with the expectation of making homes on the land and of making a living by farming. Many others have no thought of homemaking or of farming. Their aim is to get possession of land which may be sold later at a profit. In both classes one finds many individuals who know little or nothing of farming as well as those who lack the physical or mental qualities that are necessary to cope successfully with the new and often trying conditions of pioneer life.

There have been many serious misconceptions cur-

rent regarding pioneer conditions on newly irrigated lands. In many respects those conditions are less severe than those encountered by the pioneers who cleared and broke the prairies of the upper Mississippi valley. There is this difference, however, it takes more capital and more agricultural skill to develop and bring into production an irrigated farm than was required to make a self-supporting home on the humid prairies. The contrasts are more apparent, too, between the settled and orderly life of the older regions and the uncertainties of the new because of better communication. Modern pioneers to the new lands of the West are no less capable and no less courageous than their ancestors who settled Ohio and Kansas. Those early pioneers endured great hardships and made many mistakes. Many of them failed. With the lapse of time these mistakes and failures are largely forgotten and only the successes are in evidence or remembered. In the settlement and development of new irrigated areas there must be inevitably much hardship and many failures.

As the incoming settlers take up the land the initial conditions of diversity are emphasized. It is part of the equipment of a good farmer to be able to select good land and to appreciate its relative value. The natural result is that when the new region is finally settled, one finds the good farmers on the good land and the poor farmers on the poor land. While the situation is not peculiar to irrigated land, its consequences are made more conspicuous there because of the greater importance of community relationships and responsibilities. In an irrigated district each farmer is expected to contribute his share toward liquidating the cost of the project works and to the annual cost of operating and maintaining them. If he fails to do this, the burden falls heavier on his neighbors. If a few individuals in a community fail to meet their community obligations it is only natural that others, though possibly better able to do so, should mark time and wait to see whether the penalties for non-payment are really to be enforced.

The management of an irrigation project is essentially an engineering job. But the engineer whose lot is cast in such work finds his path beset with problems for the solution of which there are no formulas in his engineering handbook.

Sustained Productivity

There have been a number of instances both in this country and in the Old World where the productivity of irrigated land has been comparatively short-lived. In some of these the causes have been obvious, on others obscure. There appears to be no valid basis for the view sometimes advanced that irrigation farming cannot be continued indefinitely on the same land. Nor is there much foundation for the belief that irrigated lands are made increasingly productive by the salts carried in irrigation waters. Among the factors that influence crop yields, the so-called plant-food elements in the soil are probably not of the first importance. On irrigated lands as elsewhere, such factors as weeds, insect pests, and plant diseases are likely to be more potent in reducing crop yields than the lack of fertility as that phrase is commonly understood.

Irrigated lands may be made unproductive through the accumulation of salts in the soil or by the rise of underground water. These hazards are characteristic of irrigation and merit serious attention. The other factors mentioned above, that contribute to reduced production, operate on irrigated land as elsewhere. It is probable that the chief justification for a rotation of crops is that the practice affords an opportunity to keep down weeds and reduce the ravages of insect pests and plant diseases. It is well known that certain leguminous crops such as alfalfa and clover leave the soil richer in combined nitrogen which may benefit succeeding crops. And nearly every soil responds in productivity when its supply of organic matter is increased as by the application of manure or by plowing under crop residues. It is sound agricultural doctrine to recommend crop rotation, the use of farm manure, and of green manure crops whenever possible. But none of these nor all of them together can be warranted to maintain or increase the productivity of irrigated land.

Where the quality of the water or the methods of irrigation are such that soluble salts accumulate in the root zone of the soil, an ultimate decrease in productivity is inevitable. The symptoms or apparent causes of such decrease may be very different with different crops. With some crops the symptoms are similar to those of drought or shortage of water. With others there may be shown an increased susceptibility to disease. Certain of the non-parasitic maladies or "physiological diseases" of orchard fruits appear to be associated with conditions of malnutrition which may be due to abnormal concentrations of the soil solution. There is very little that is definitely known concerning these causes of reduced productivity. It seems highly probable, however, that other causes than the exhaustion of the supply of plant food must be found if this problem as it exists on irrigated land is to be correctly understood.

The causes that contribute to rapidly decreasing productivity on irrigated land are now under investigation by a number of state and federal agencies. It is clear that those causes must be understood and remedies devised or the future of irrigation in this country is in danger. The investigations now most actively pressed have to do with the alkali problem and with those non-parasitic diseases that are so serious in sections devoted to orchard fruits. The progress so far made in these investigations is encouraging and there seems to be good reason for hoping that the agriculture of an irrigation project may be as permanent as the dam.

Live-Stock Industries

The focus of popular interest in irrigation farming centers on crop production, yet the welfare of the people engaged in such farming is largely determined by their success in using or disposing of their crop products. Though much of our irrigated land is well suited to, and is used for, the production of forage and grain crops, many of the projects are located far from large markets so that their products must bear heavy transportation charges. When such bulky products as hay and grain must be shipped long distances to market, the cost of transportation becomes a large part of the market price. Wherever it is possible to do so, these bulky products should be fed to live-stock on the farm or at least within the community where they are produced. It may cost $10 per ton to ship hay or grain to market and $20 per ton to ship butter or meat animals, yet it takes at least 30 pounds of hay or 5 pounds

of grain to make a pound of butter or a pound of meat.

There are, in addition, two other valid reasons for feeding the bulky crop products on the farm. The first is that it provides remunerative employment at seasons when the labor requirements of crop production are low. The second is that farm manure is unquestionably helpful in maintaining crop yields.

A large number of irrigated areas are located in the midst of extensive areas of range land or between the range lands and live-stock markets. Such advantages of location should be utilized as fully as possible. The products of the irrigated lands such as hay, grain and beet tops are now used extensively for wintering range stock or for partly finishing cattle and sheep for slaughter. There are certain hazards and disadvantages to the use of crops in this way due to fluctuation of demands and of prices from season to season. In consequence the profits may be large one season and the losses may be heavy another season.

Returns are much more certain and in the long run, may be fully as good, where the forage and grain crops are fed to dairy cows and hogs. Dairying and hog production fit together well because the hogs make good use of skim milk and buttermilk which are by-products of dairying. Climatic conditions on many of the projects are well suited to these industries. Irrigated pastures of mixed grasses and clover for dairy cows and alfalfa pastures for hogs provide cheap, excellent summer forage. These conditions give our irrigated land advantages which may more than offset the handicap of distance from market and enable them to compete successfully with the dairy sections of the East and Middle West. In fact the center of the dairy industry is moving westward and on several of the northern and intermountain projects dairying is proving to be the way to economic salvation.

On some of the projects, dairying is made difficult or impossible because of the lack of suitable supplies of water for domestic and stock use. Where there is no underground water available or where it is very salty, it is not easy to carry on dairying. This is a fact which merits the attention of irrigation engineers, for the difficulty, where it exists, is one which they should find a way of overcoming.

Economics of Irrigation Farming

In a time like the present when agriculture is in a state of depression it is particularly difficult to formulate conclusions concerning conditions on the isolated and widely scattered irrigated areas. On many of them the pinch of deflation has been most distressing, on others it has been much less acute. On the whole, it appears that where the system of agriculture was fairly well balanced and particularly where dairying and associated live-stock industries were well established, there has been little downright hardship. There has been a pause in the expansion of operations and of credit that characterized the war period. Land prices have declined sharply, production less sharply.

There are two different points of view from which irrigation farming has to be considered. One is from the standpoint of the individual who is or may become engaged in it and the other is from the standpoint of the country as a whole. Farming under irrigation may be compared with dry farming which is often carried on nearby under similar climatic conditions or it may be compared with the more intensive farming that is possible under conditions of ample rainfall. When compared with adjacent dry farming, the chief differences are that the cost of production is higher per acre under irrigation, and consequently the returns must be higher than for dry farming if the enterprise is to be profitable. An assured supply of irrigation water reduces the hazard of drought but it does not protect against such troubles as hail and frost and the ravages of insect pests and plant diseases. The fixed and labor costs of farming with irrigation are so much greater than with dry farming that irrigated lands cannot be expected to compete successfully with dry lands in grain production.

The slightly larger yields obtained by irrigation do not justify the increased cost of water and labor. Each acre of irrigated land must be made to yield two or three times as much in crop value as dry land to make it pay. Comparisons between irrigated land and other equally expensive land in distant parts of the country are not satisfactory. There is a tendency to rate irrigated lands at prices rather above those of lands of equal productive capacity in humid regions, notwithstanding the fact that the labor cost of crop production is substantially higher under irrigation. The implication is that the agricultural value of an assured water supply is probably overestimated. If there is to be any material extension of irrigation in the West such extension should be determined largely by the needs of western markets for the products of irrigated land. It is not to be expected that these isolated lands located so far from eastern consuming centers can compete with eastern farms in such crops as potatoes and hay. In any event there is need for the greatest care in selecting the land to be irrigated. The future will undoubtedly see less irrigation of land of doubtful productivity.

Home-Making Value—From a national standpoint our irrigated lands have a value far greater than that of the contribution they make directly to our supply of agricultural products. These lands provide farm homes for possibly 100,000 families. They make it possible to utilize enormous areas of arid and semi-arid land for pasture and for grain production which could not otherwise be used.

These considerations cannot be overlooked in taking stock of the present situation or in dealing with the policy of future extensions. It seems altogether probable that the construction costs of the projects that remain to be built will be higher than for existing projects. While it is doubtful if present agricultural conditions justify the rapid and large-scale extension of the irrigated areas in the West it is true that the local requirements of other industries and developments appear to justify a steady forward movement in irrigation construction. There are many projects, large and small, yet to be built. Conditions change from year to year in this new country. Factors that determine the feasibility of a project are influenced by these changes. Meanwhile there is every reason for maintaining and protecting the welfare of the projects already built and of solving those problems which stand in the way of their continuing prosperity.

[*Further articles in the series will deal with past experiences and problems of reclamation and with future development. In next week's article Dr. F. H. Newell will summarize the twenty years of achievement in reclamation. The following week George F. Kreutzer will discuss land settlement problems.*—EDITOR.]

Locomotive Shop Served by 180-Ton Crane: M.-K.-T. R.R.

Transverse Track Layout—Main Building Houses All Shop Facilities—Enlargement and Future Transfer Table

IN A LARGE steel-frame locomotive repair shop recently erected at the Bellmead terminal of the Missouri-Kansas-Texas R.R. at Waco, Texas, the engines will enter and leave the building on yard tracks and all interior handling of the engines will be done by an overhead crane of 150 tons capacity. This arrangement avoids the expense of a transfer table, but the plans provide for such a table when the shop is enlarged to double its present capacity of twenty engines per month. The present and future shop layout is shown in Fig. 2, and directly behind the main building is the engine terminal.

The transverse type of arrangement of shop tracks and pits was adopted after consideration of such factors as man travel, handling of materials and engine parts, concentration of work of similar character, supervision of the shop and the adaptation of the present construction to a compact plan for future development. As shown in Figs. 2 and 3, the main part of the shop has two longitudinal bays, an 80-ft. erecting bay and a 71-ft. machine bay. Two overhead traveling cranes serve the erecting bay, the upper one being a 75-ft., 180-ton crane to handle locomotives and the lower one a 15-ton crane to handle material. There are fifteen repair pits, 50 ft. long and spaced 25 ft. c. to c. The pit tracks are extended 8 ft. into the machine bay, so that in front of the engines there is space for wheels within reach of the 15-ton crane of this bay which carries the wheels to and from the machines or the storage platform.

Two track connections are provided. One of the pit tracks at the south end is connected to a yard track and at the north end a through track extends across the shop. Engines entering in this way will be picked up by the 180-ton crane and placed at the assigned repair pit. In the same way, completed engines will be picked up and placed on one or other of the tracks for removal from the shop.

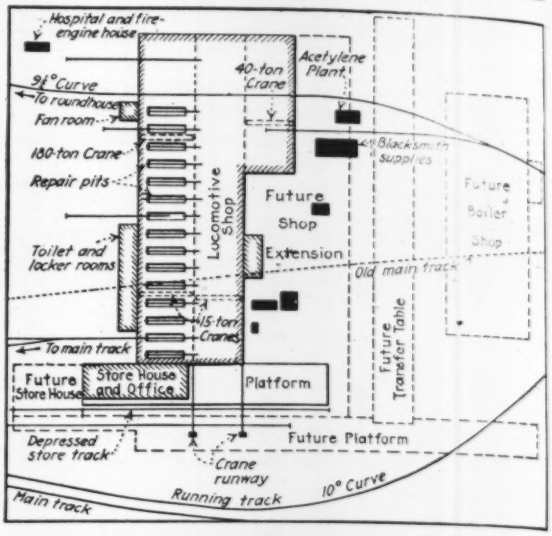


FIG. 2—NEW SHOP LAYOUT AND FUTURE EXTENSIONS

In the enlargement of the plant for its ultimate capacity of handling heavy repairs to forty engines per month, the shop will be widened instead of lengthened, each transverse track then having two pits. Thus there will be two 80-ft. erecting bays with two 71-ft. machine bays between them, each 80-ft. bay having a 180-ton crane for handling the engines. At the same time a transfer table will be provided in front of the new part of the shop and will serve both the repair shop and the future boiler shop, which will be 352x142 ft., located as indicated in Fig. 2.

Economical operation of the shop as now built and provision for future development with a minimum expense for interior rearrangement of tracks and pits were main factors in the design of the building. An outstanding feature of the work as now built is the concentration of all the principal shop facilities under one roof. The main building, which comprises the erecting and machine bays, is 477x156 ft., with a blacksmith and tank shop in an extension 202x71 ft., served by a 40-ton crane. At the rear of the erecting bay is an addition containing the toilet, locker and wash rooms. The boiler shop occupies the four north bays of the main building, next to tank and blacksmith shops.

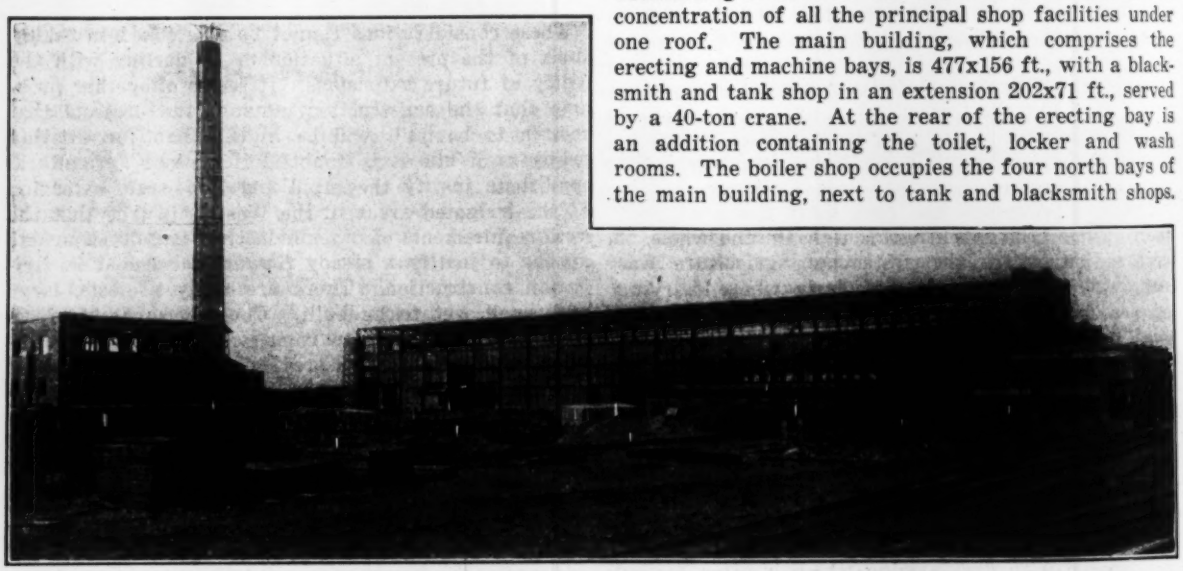


FIG. 1—LOCOMOTIVE SHOP AT WACO, TEXAS; MISSOURI-KANSAS-TEXAS R.R.
The long steel building contains erecting, machine, boiler, tank and blacksmith shops. Storehouse and office building at right. Locker rooms in low structure behind main building. Power house at left.

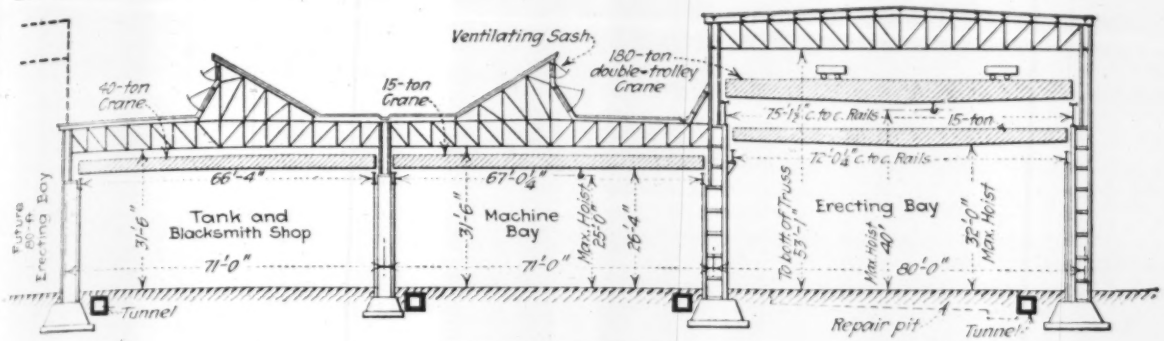


FIG. 3—CROSS-SECTION OF REPAIR SHOP

At the opposite end is a two-story extension 152x50 ft., with store rooms on the lower floor and the shop office and tool manufacturing room on the upper floor. A platform for the storage of castings and heavy articles adjacent to the storehouse is served by the 15-ton traveling crane of the machine bay. This crane passes through the end of the building and its runway extends over the storehouse platform and track, so that wheels and heavy castings can be handled directly between the car or platform and the shop machines. This layout of the several departments is planned with a view of providing the most convenient handling of material and reducing to a minimum the amount of man travel.

Steel-frame shop construction consists of columns spaced 25 ft. c. to c. longitudinally, connected by struts and girders and supporting the roof trusses and crane runways. In the lofty erecting bay the columns are offset near the top to form seats for the girders of the 180-ton crane; the 15-ton crane has its outer runway carried by flanged members forming offsets on the columns, while the inner runway is carried by brackets on the columns. The two lower bays have a modified pond truss or sawtooth roof arrangement with hinged sash on the glazed fronts. Hinged sash is provided also along the top of each side of the erecting bay. Steel sash with factory wire-glass composes almost the entire wall area, with ventilating sash in many of the panels. The ends, however, are partly of brick. Track entrances are fitted with swinging doors of steel frame and steel sash. The roof is of cement tile laid on the purlins and covered with composition roofing. Mastic surface on reinforced concrete is used for the shop floor. Electric current for power and lighting, purchased from the Waco plant of the Texas Power & Light Co., is distributed by cables and conduits laid in floor conduits. New machinery equipment will be used throughout, with individual motors for the tools and other machines. A circuit with self-registering apparatus provides for checking machine performance. For heating the main shop there is a fan system by which air taken from the outside is warmed by being passed over steam radiators and then blown through underground ducts to vertical pipe branches with discharge hoods about 8 ft. above the floor. Radiators for direct steam heating are used in the offices and store room. Steam and compressed air for the shop and engine terminal are supplied from a power house with two 328-hp. boilers, two air compressors of 2,000 and 500 cu.ft. capacity and duplicate fire pump equipment. Oil fuel is used, but the plans provide for future coal and ash handling facilities if these should be necessary. This building is of brick and steel, with an 8-ft. concrete smokestack 177 ft. high.

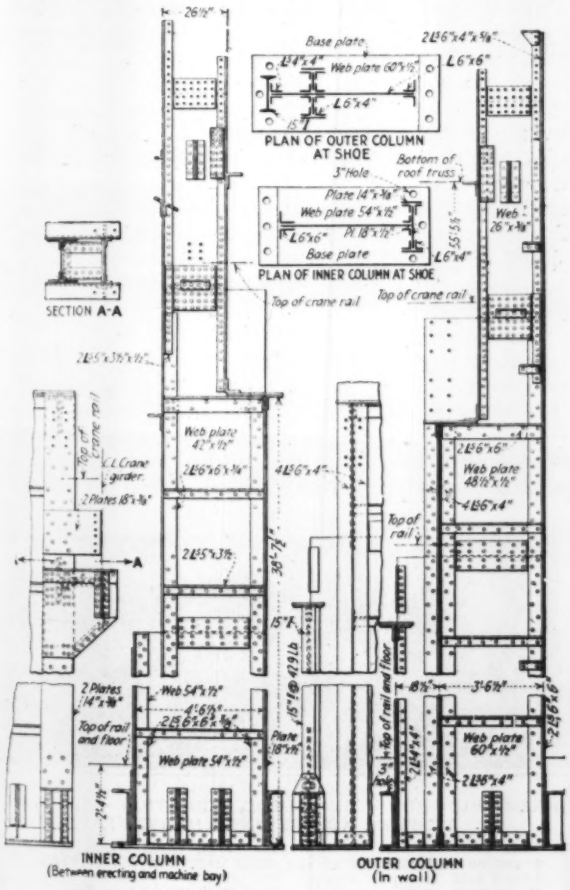

PLAN OF OUTER COLUMN AT SHOE
PLAN OF INNER COLUMN AT SHOE
SECTION A-A
INNER COLUMN (Between erecting and machine bay)
OUTER COLUMN (In wall)

FIG. 4—COLUMNS AND CRANE RUNWAYS

Minor works now being built as part of the shop plant include a supply building for the boiler and blacksmith shops, a paint shop, fire engine and hose house, first-aid room and a brick lavatory and locker room for the roundhouse employees. For safe and convenient communication between the plant and a city street a concrete subway 8x8 ft. and 355 ft. long has been built under the intervening freight yard. At the rear of the repair shop is the engine terminal, with 15-stall roundhouse, back shop, two ashpits and facilities for supplying the locomotives with water, sand and fuel oil.

Preparation of the site required about 140,000 cu.yd.

of grading and about a mile of relocation of the main line, the old main track now forming the east approach to the shop and terminal plant. The general contractor for the building was H. D. McCoy, Cleburne, Texas; grading and concrete work, including foundations and shop pits, J. E. Hutt Contracting Co., Kansas City, Mo.; furnishing and erecting structural steel, Mt. Vernon Bridge Co., Mt. Vernon, Ohio; electric power installation, Beckett Electric Co., Dallas, Texas.

This Bellmead shop plant represents the last item in an extensive program of shop, yard and engine terminal improvements carried out on the Missouri-Kansas-Texas Lines during the receivership which ended early in 1923. All design and construction work are under the direction of F. Ringer, chief engineer, M.-K.-T. R.R.; assisted by J. M. Metcalf, principal assistant engineer; A. L. Sparks, architect; and M. C. M. Hatch, mechanical engineer. E. W. Metcalf is engineer in charge at Waco. The shop itself is estimated to cost $1,700,000.

A Study of Vibration in Francis Type Water Wheels

Serious Vibration in 40,000-hp. Unit Cured by Increasing Runner Clearance—Device Measures Pressure Variations

A PAPER on vibration in Francis turbines was presented at the Pacific Coast convention of the American Institute of Electrical Engineers held at Del Monte, Calif., early in October, and was frankly discussed by manufacturers and power company engineers with the result that facts of great importance in the field of water-wheel design were brought out. The paper, by Roy Wilkins of the Pacific Gas & Electric Co., was entitled "A Study of Irregularity of Reaction in Francis Turbines." The following is a resumé of chief points of the paper combined with notes on the discussion from the floor of the convention as reported by a member of *Engineering News-Record* staff. One point not mentioned in the paper or in the discussion, but which should be pointed out so that the reader may grasp the situation, is that the turbine in question has a capacity of 40,000 hp.

The power company found a newly installed Francis turbine which had excessive vibration and proceeded to develop means of studying and analyzing the causes. The vibrations were found to be caused by changes in hydraulic pressure and to have a period in the order

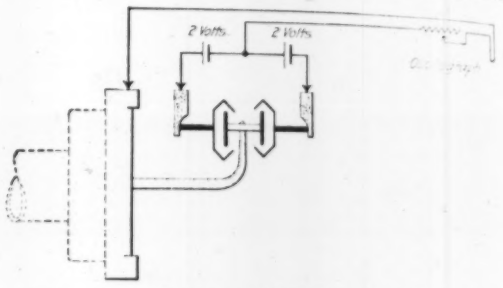


FIG. 1—DIAGRAM OF CONNECTIONS IN THE RECORDING DEVICE

of electrical frequencies commonly used; hence they could be recorded by standard oscillograph methods. A device was built for measuring these pressure variations which consisted of a 1½-in. pipe union carrying a diaphragm of spring steel to the center of which was attached an arm extending to a pair of microphones of the variety used in wireless transmitting sets.

The outer elements of these microphones and a wire grounded to the union, as shown in the diagram, formed an elementary bridge with microphones and batteries as members and the oscillograph element as detector. This device could be tapped into turbine casing or penstock at any convenient point, a ½-in. connection, if not too long, being ample to actuate it. In most of the records made with the oscillograph the vibration of a 60-cycle wave was also recorded simultaneously on the sensitized surface for purposes of comparison.

The first tests were explorations of pressures on the runner vanes. These were made by the use of a Pitot tube traveling with the runner and passing to the center of the draft tube whence a packing gland made connections leading out to the device described above. By filling the rotating tube with air under pressure and then closing it at the instrument end, the air is trapped under the water pressure in the turbine and centrifugal action and leakage are minimized. In this way the whole face of the runner entrance was explored under actual operating conditions. Records were made of pressure variations occurring at various points in the revolution.

Having completed an exploration of the unit that vibrated excessively, the newly developed device was used to test other reaction turbines of the system, the idea being to compare the amount of vibration with features of design in several turbines under different conditions of load, head, etc., to determine, if possible, what features or conditions caused excessive vibration.

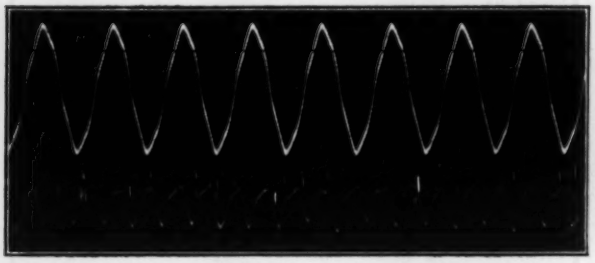


FIG. 3—RECORD OF RESONANT VIBRATION—THE OBJECTIONABLE SORT

This unit had 19 runner vanes and 20 guide vanes. The hum was apparent in both powerhouse and penstock. The generator of 5,000 kw., was 220-lb. pressure and 450 r.p.m. The upper curve is a 60 cycle wave recorded simultaneously for comparison.

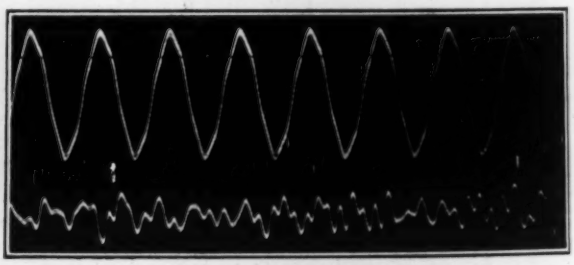


FIG. 4—RECORD OF IRREGULAR VIBRATION—THIS WAS NEITHER AUDIBLE NOR HARMFUL

This unit had exactly the same scroll case, speed, water pressure and capacity as the other unit, but had 17 runner vanes and 20 guide vanes. The pressure variation shown is as high as in the other case, but there was no harm or vibration.

The final conclusion was that vibration in the unit giving trouble would be decreased by increasing clearance between the guide vanes and the turbine runner. It was decided to do this by cutting down the runner with an oxyacetylene torch. The cuts were made on the 15-in. face of the runner vanes where the metal was 1⅞ in. thick, a 15x2½-in. piece of metal being taken

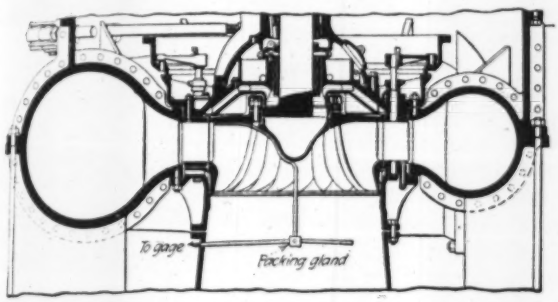


FIG. 2—LOCATION OF PITOT TUBE IN RUNNER

off each vane, thus decreasing the runner diameter by 5 in.

This change increased the thickness of the water ring around the runner and very materially decreased the vibration. How this change has affected the efficiency of the unit and whether a new runner, finished in the shop to the smaller diameter, is to be substituted later, was not announced but at least the information brought out establishes the fact that most of the vibration was eliminated by increasing the thickness of the water ring around the runner.

Tests made on this and on other units led to the conclusion that a sufficient thickness or width of the water ring around the runner is essential if harmful vibration is to be prevented. The power company interpreted their tests to indicate that if the water ring was thick enough the shape of the guide vanes was not important. This latter point differed from the conclusion of the water-wheel manufacturers as expressed at the convention, their tests and experience indicating better results with improved guide vane design.

FIG. 5—PIPE UNION CARRYING DIAPHRAGM AND MICROPHONES

Until recent years irregularity of reaction has been of little importance and has been treated as a more or less necessary evil. However, the danger of vibration increases with the head, and features of design satisfactory for low heads may give trouble under high heads. Uneven or irregular vibrations do not set up a condition of resonance and therefore are less audible and less injurious to the equipment than uniform pulsations which cause resonance and permit a maximum amplitude of vibration. For this reason certain limitations should be observed with regard to the relative number of guide vanes and runner vanes. If there are one, two, four or six more runner vanes than guide vanes, once every revolution, due to the vernier effect, a corresponding number of runner vanes simultaneously pass guide vanes, thus harmfully combining the effect of pressure changes due to the transit from the leading to the trailing side of runner vanes. On the other hand, with three, five or seven more runner vanes than guide vanes, the vernier effect occurs irregularly and although there is the same combining of pressure changes, these combinations recur at irregular intervals and cannot do the harm that results from resonant vibration.

The entrance angle and the amount of change in direction which the water is obliged to make between guide vanes and runner is another factor in the complex cause of vibration. There must not be, at any gate opening, necessity for a change of direction in the flow of water between guides and runner greater than can be accomplished without disrupting stream lines. Of course the permissible limits of this angular change decreases with decreased clearance and with increased head.

Reference was made in the discussion to vibration in large units under low head that had been muffled by heavy bracing; there was frequently repeated commendation of the device for recording turbine vibration described in the paper and a general agreement that much more study of the subject was needed particularly with the co-operation of power companies and water-wheel manufacturers.

A British Narrow-Gage Railway

A 12-mile line of 23½-in. gage has become a part of the system of the Great Western Ry., England, by the recent consolidation of British railways. This is the Vale of Rheidol line, in the mountainous part of Wales. With one continuous grade of 2 per cent for 6¾ miles, engines of relatively high power are required and the Great Western Ry. shops have recently built two 25-ton side-tank engines of the 2:6:2 type having a tractive effort of 10,510 lb. Double-truck open cars are used in summer, having the roof supported by light posts and carrying curtains to be let down in wet weather. Each car, 32 ft. long and 6 ft. wide, accommodates 48 passengers on cross-seats, an aisle or gangway being left along one side.

Through the Reclamation Country

By F. E. Schmitt
Associate Editor, *Engineering News-Record*

THIS is the sixth of the series of letters written by Mr. Schmitt during a journey recently made through the West in which he visited irrigation projects, studied developments, and interviewed builders, operators and settlers, in order to present to our readers the actualities of reclamation as revealed to an unprejudiced investigator.

The series of letters began in the issue of October 4.

Delhi, Calif.

HERE at Delhi is located the second and newer of California's state-aid irrigation settlements. Much can be learned here about the difficulty of getting under way on an irrigated farm. It puts emphasis on the fact that the settler's money problem at the time of first starting out is one of the most difficult elements of irrigation development. But this fact is apparent on any reclamation project; few or none of them are fully settled up, and starting up may be seen in all its phases, in addition to which its long-time effects are more or less evident. It seems that many of the troubles and bitternesses existing on the projects trace back to the initial money difficulties.

A banker in a project town told me, in getting down to brass tacks on reclamation troubles, "This irrigation farming isn't a poor man's game. The man who has only $1,000 shouldn't expect to come here and make a go of it." And Walter E. Packard, superintendent of the Delhi settlement, said something similar in speaking of how he assures himself not only that the intending settler is suited for farming but also that he has sufficient capital: "The financial problem of the settler is the most important one we have to deal with in developing our project."

Estimates made by various men on reclamation projects indicate that 30 to 35 per cent of the original settlers are still there, or that about twice as many as are now there have come and gone again. Since some few left because they could sell at a profit, this probably means that there have been two "crops" of settlers. Many of the first crop were squeezed out by the consequences of trying to start out without money.

Initial Money Needed—It costs more to start up farming under irrigation than elsewhere. But most settlers come to a reclamation project with very little money to spare. On a very optimistic guess based on a few statistics, it might be said that the average settler has $1,000 to $2,000 when he first sets foot on his land. He must spend some $4,000 to $6,000 before he is established and has a crop in prospect. Where is the money to come from?

Two bankers may be quoted. A Joint Stock Land Bank official, when the question was put whether it is easy for the reclamation farmer to get money for starting in, bluntly said no; that there is no security for a loan. The case is the same as that of a home builder who owns a lot and wants to build a house but has no money—the lot is no adequate security for the house loan. Building-loan systems have been worked out for the latter case, but no such system has been established for the reclamation farmer. I asked a Federal Land banker, "Can a method of financing the reclamation farmer's start be worked out?" He answered, "I see no way in which it could be done"; but he did express himself hopefully about the method adopted by California—a state loan backed by retention of title and further secured by state supervision of its expenditure, which is not very far from a building-loan system.

Figures on the farmer's initial money requirements differ widely but a little generalizing may help to explain. He comes on a raw, unleveled and unfenced piece of land with a ditch leading water to one corner of it. He must build distributing ditches, which may cost $10 to $15 per acre; he must level his fields to receive the water and border them to retain it, at a cost of $10 to $100 an acre; he must spend $2,000 to $2,500 on fencing the land, building a house and barn, and buying stock and tools—and this is a low estimate. Finally he must plow and seed the land (another $10 to $40 per acre) and then sit down and feed his family while waiting for returns. The case is just the same on a Carey Act or district project; reclamation problems are not a particle different from irrigation problems on other projects.

For Delhi, Mr. Packard figures as follows: $50 an acre for the distributing pipe; $20 for leveling (this is a minimum estimate, and under the bad loose-sand conditions at Delhi is likely to be exceeded often); $85 for buildings, water supply, etc.; a total of $155 per acre—all this after the settler has bought the land at $220 per acre! And the farmer makes his payments on all this money, *with interest*, and pays his water charges too. He pays or he gets out.

But to return to the reclamation project: Some money can be borrowed on the raw land, of course—at 10 per cent, a ruinous rate for fixed capital investment. The shrewd and hardy pioneer will do without usurious loans where possible, and manage by hook or crook to dig his way through the first year without much money to speak of. But this type of man is an exception, and it is hardly surprising under the circumstances if more men fail than pull through during the pioneer period. Yet many serious-minded people profess to regard the two to three crops of settlers as an indictment of reclamation, or of governmental awkwardness or something. Half a dozen farmers and irrigation managers have told me that they see no way of avoiding the three crops, and that the weeding-out process is inevitable.

California State-Aid Plan—On the California state settlements, the state finances the farmer's start, and it also requires that he must have money enough of his own to pay for 10 per cent of the cost of the land and 40 per cent of the improvements. The whole case is extremely interesting, but the point for the present is the result, as compared with reclamation results: At Delhi the settler has to invest very much more in the land than on any reclamation project, has to invest just as much in improvements, and has to repay in full, with 5 per cent interest running from the very first day; and practically 100 per cent of the farmers there manage to do this. The unfinanced reclamation farmer, with much less to pay and with the interest on the cost of the irrigation works generously thrown off, fails in 50 per cent of the cases, and even where he survives he claims (or his loud-voiced representa-

tives claim) that he cannot pay the modest construction cost installments, *which are less than interest on the cost.* The comparison is not to the credit of the reclamation farmer; but it shows, among other things, that initial financing is a very important matter.

There is something to be said on the other side of the case. I have seen a number of reclamation farmers who started out with nothing and made a pronounced success—on the North Platte, Grand Valley, Minidoka, Umatilla, and Newlands projects, and probably they can be found on all. One of these farmers said, "A man who gets right down in the dirt and roots can't fail to make a success of irrigation farming here"; and he was one who had had no farming experience, being a former railroad carpenter. Genuine pioneering, in other words, still has its place.

Inflated Ideas of Pioneering—The oldtimers who went out into the Western forests and prairies to hew out a home did not generally start out with money, I believe, or get any extensive bank loans, but made a start somehow (though doubtless a lot of them failed, too). Irrigation farming is said to be harder than making a start in the woods, but the Mormon immigrants that finally reached the Great Salt Lake desert and irrigated it did not make a start with money, but very successfully starved themselves through the first year. Allowing for all the difference between former and modern conditions and needs, one is bound to give much weight to the opinions of long-time observers of irrigation conditions who say that one of the weaknesses of irrigation development is in the quality of the settlers, their inflated expectations, lack of readiness to endure hardships, and lack of instinct to help themselves and to win out. A Washington engineer attributes many irrigation failures to amateur settlers who "thought they only needed to tickle the soil to become rich, and when they found that they had to work two or three years they gave up."

Nevertheless, the settler's finance problem strikes me as very serious. The lack of reasonable credit discourages and pinches many who could otherwise make a successful start, and it loads up others with heavy interest charges that force them to plan their whole system for making money rather than making a living. It also leads to the loan company or banker becoming more important than the government or the project manager.

There are failures even under the Delhi system. But the failures are detected quickly (Delhi is less than three years old) and are weeded out promptly without the obstacle of ill-guided Congressional or Departmental mawkishness. The state is in the position of primary creditor and asserts itself; if a man is closed out it is the state that closes him out, and it does so before the state's equity has become impaired. On well-managed private or district projects something of the same kind happens. On federal reclamation projects the government never takes action to protect its lien or its equity but the loan creditor is always the one who closes the farmer out. So, very naturally, the mortgage or bank loan is the important obligation to the farmer, while the government obligation is unimportant—so unimportant that it really isn't there at all. As a private project manager told me, "We close out the failures promptly. The government can do the same thing; and it would, if it were left alone by the Secretary."

Project Management—As a matter of fact, the ordinary reclamation project may be compared to a $5,000,000 to $15,000,000 corporation doing a yearly business of several million dollars. The project manager is the executive head of this enterprise, and if he is supposed to develop the property and make it efficient he ought to have just the same freedom of action as the president of a manufacturing or commercial enterprise of the same size. But under the Department's practices the project manager has very little executive authority and is not expected to lead; he is powerless to prevent his farming community from going to the bad or to lead it on to improved methods of work.

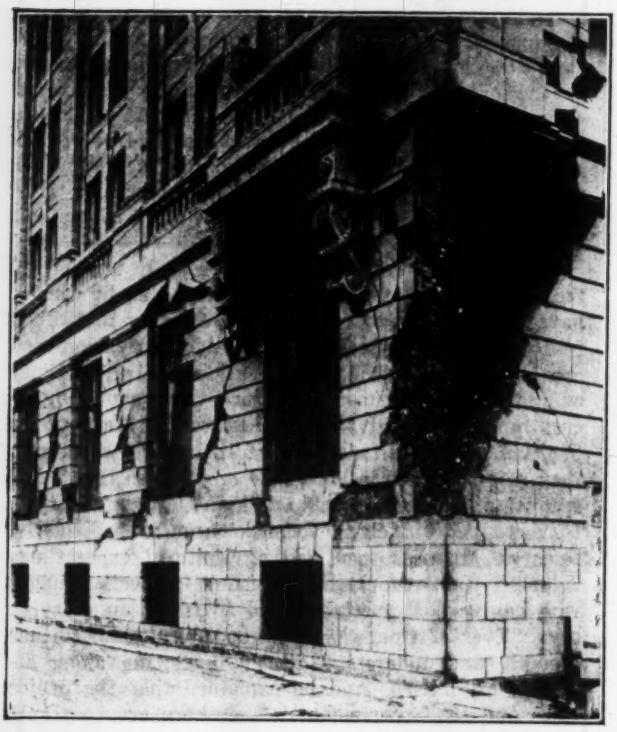
This point is important because hardly any of the reclamation projects that I have seen or about which I have heard are up to a productive efficiency that might reasonably be expected of them. Since irrigation costs money, the land should be brought to high productivity, as against the very mediocre productivity shown by the crop figures which I reported last week. Many of the projects raise alfalfa as one of their main crops, and they ship it as hay, a low-grade crop, when they might feed it on the farm and ship milk and butter. Dairying is very inadequately developed on most projects, so farmers, business men and agricultural experts say. John F. Richardson, the Newlands project manager, who has worked specially hard to bring up dairying, says, "Every farmer that has good cows, tends to them decently and understands them, is getting along and paying his bills." And he explained that the project office and the experiment station there are constantly preaching the doctrine of "cow dung, elbow grease and butter fat" as the way to success.

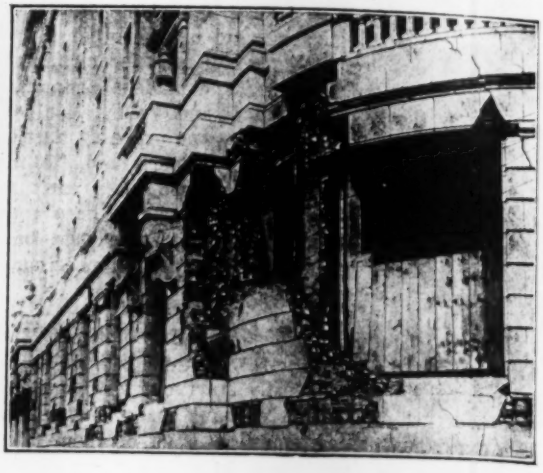
Selecting the Settler—One interesting thing in the Delhi system is its wide difference from that by which reclamation projects are started up. At Twin Falls I heard a lively eye-witness story from a man who former lived in Billings, of how the Huntley reclamation project was opened with a grand land lottery. High officials of the Land Office were there from Washington—how on earth they butted their way into a reclamation proceeding I can not imagine—a little girl in a pink sash drew tickets out of a barrel, and lucky land-gamblers who never intended to farm got the first pick of the most valuable pieces of land, which they sold the same day at a huge profit. That barbarous method has not survived; moreover, under the conditions of the past few years there has been an automatic selection of settlers, for those who came were largely men anxious to build up a farm. But it still is true in all federal and in most private irrigation developments that the new settler is simply dumped on the land and allowed to wrestle with the severe problem of financing and the difficulties of a strange soil and country without the slightest help.

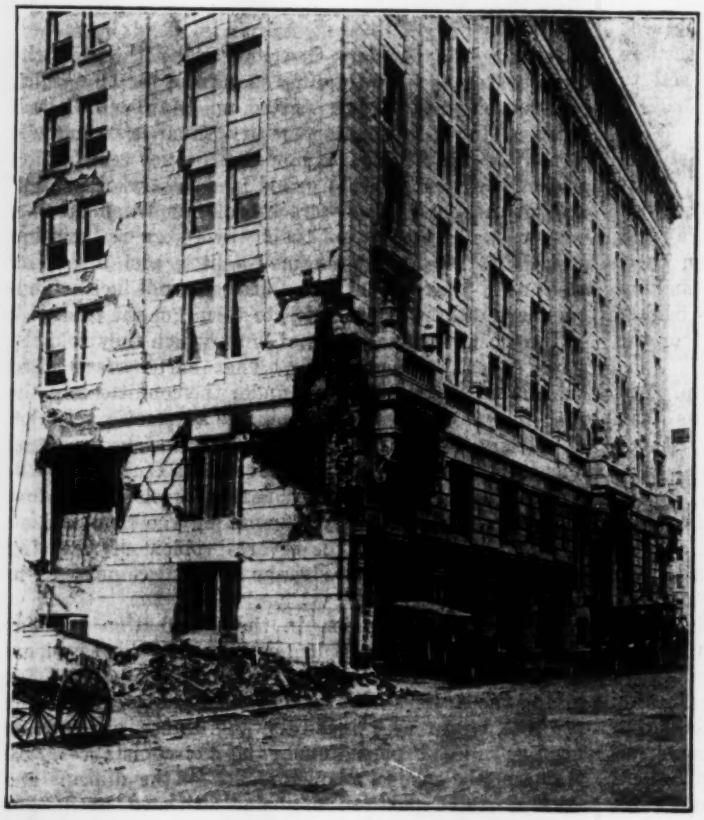
There is no provision in the reclamation law for financing the settler. It has even been decided by legal talent that the Reclamation Fund can not be used for giving the settlers advice. The results obtained on the projects, so far as I have been able to see, are fully as good as can be expected under these circumstances. All through, the project managers are in the difficult and uncomfortable position of being expected to develop their projects into successful farming communities by sheer faith and hope. They have performed brilliantly, even if they are engineers.

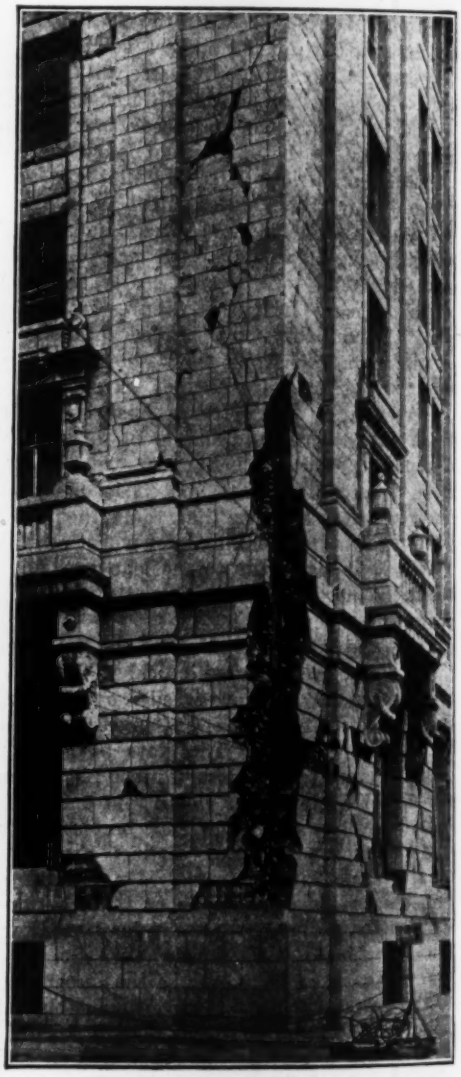
How Three American-Built Steel-Frame Structures in Japan's

Photographs Supplementing Report in Last Week's Issue by Wilbur S. Sample, Engineer





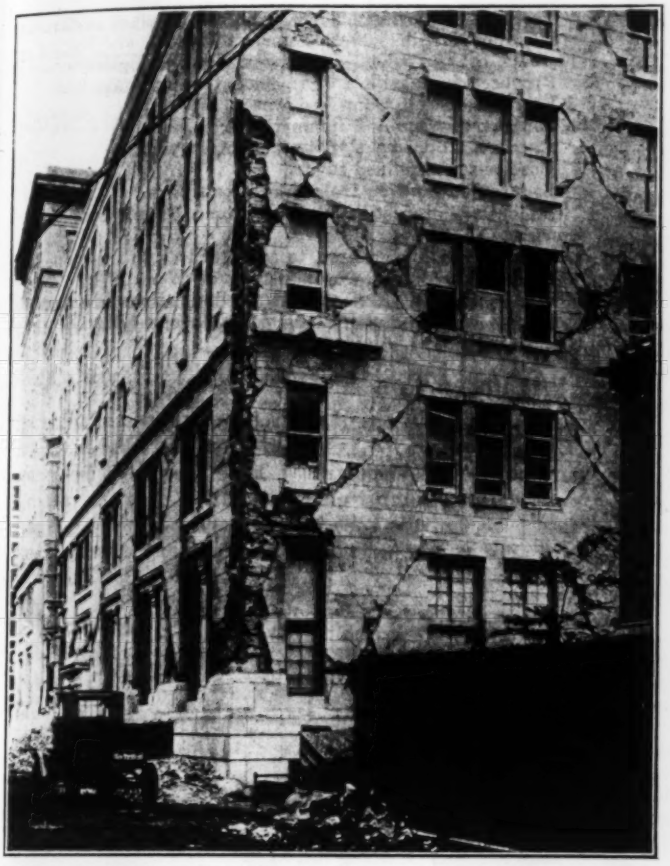


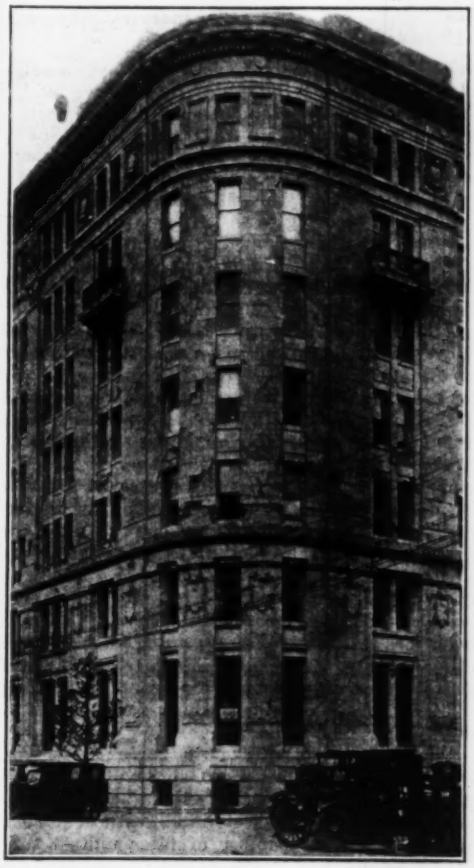


THE N. Y. K. BUILDING—No permanent distortion of the steel columns occurred but a large percentage of the masonry piers enclosing the exterior wall columns and the plastered partitions between the interior steel columns were shattered.

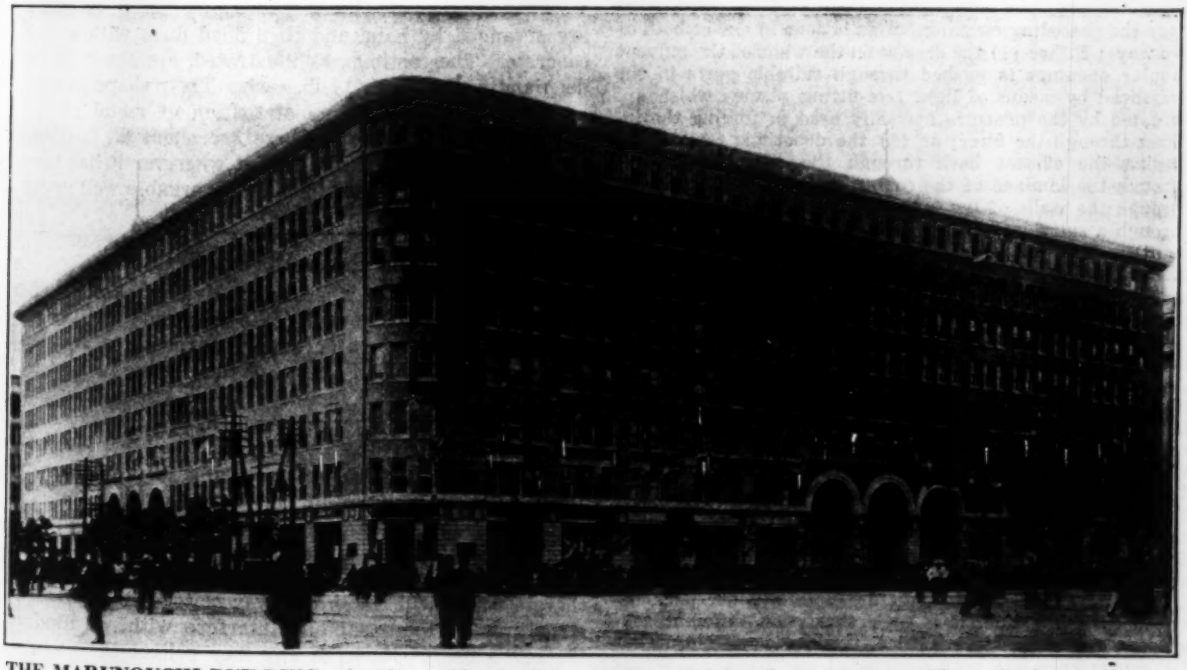
Capital Withstood the Violent Earthquake Shocks of Sept. 1

For the George A. Fuller Co. of the Orient, Which Built the Modern Structures in Tokyo





THE JAPAN OIL BUILDING—Steel frame proved adequate, the principal damage being identical with that in the N. Y. K. Building, noted on facing page.



THE MARUNOUCHI BUILDING—Another evidence of the stability of the modern structure. The main damage to masonry was below the fourth story. Reinforced-concrete floor slabs and interior walls stood up well

A Novel Type of Filter

By George W. Fuller
Consulting Engineer, New York and Philadelphia

Abstract of a paper read Oct. 16, 1923, at Conference on Pollution of Streams by Industrial Wastes, Held at Engineers' Club, Philadelphia.

STREAM-LINE filters were one of the most interesting exhibits at the Shipping, Engineering and Machinery Exhibition at Olympia, London, in September. They are the [patented] invention of Dr. H. S. Hele-Shaw, last year President of the British Institution of Mechanical Engineers.

The principle of this filter was discovered last winter while experimenting with lantern projections to indicate the behavior of films under pressure in connection with the Theory of Stream-Line Motion, established by Dr. Hele-Shaw. Announcement of the discovery was made before the Royal Society May 10, 1923.

In its simplest form this filter is made of a pack of specially prepared paper, impervious to water and oil and somewhat roughened to provide passageways, the pack being held within a container between two pressheads. One of the pressheads is movable and provided with a screw arrangement for suitably compressing the many hundreds of sheets which make up the paper pack. Through the entire pack from presshead to presshead are two alternate sets of circular holes, the larger being for the influent and the smaller for the effluent. At one presshead are channels through which, under such pressure as desired, the influent is led to each of the openings of larger diameter; and at the other presshead are channels connecting with the smaller holes in order to remove the effluent. The influent, even under heavy pressure, can pass from the larger tubular openings only through the laminae of the heavily compacted pieces of paper, with stream-line motion, into the smaller tubular openings which form an exit from the filter.

These filters are built of the horizontal or vertical type. The largest stream-line filter exhibited at Olympia consisted of a battery of 16 vertical filters, each pack containing 16,000 sheets, 256,000 sheets in all, with 32 influent openings making "the total number of filter units 8,192,000." Its rated capacity was 10,000 gal. per hour.

Cleaning—Stream-line filters require frequent cleaning, depending upon the quantity and quality of influent filtered since the preceding cleaning. This is done in one or both of two ways: Either (1) the deposit on the walls of the influent tubular openings is pushed through suitable ports in the presshead by means of light free-fitting pistons which are actuated by the pressure normally used in forcing the influent through the filter; or (2) the deposit is removed by forcing the effluent back through the effluent openings, through the laminae of the compressed paper pack, thence through the walls of the influent tubular openings and out through a suitable port. I saw several packs of paper dismantled after more or less use in filtering various substances and I was impressed by the complete absence of stain or other sign of service by the paper, other than at the edges of the influent openings.

Accomplishments of edge filtration, as distinguished from ordinary filtration through a body of granular material, depend upon the ability to regulate the attenuation of the films in which the liquid passes in stream-line motion. It is essential that the material used in this new filter have a rough surface so as to provide passageways, as satisfactory results do not appear to be obtainable with smooth surfaces. The special paper now used is not only impervious and relatively cheap, but its flexibility allows pressure to be applied to the packs in varying degree, thus providing a control for the size of the passageways. As a result of passing certain mixed liquids through the stream-line filter several times, and increasing the pressure on the paper pack between each filtration, it is understood that different substances are removed each time, thus accomplishing what for convenience has been designated as "fractional filtration." The paper in use is said to withstand ordinary acid solutions up to 10 per cent strength, but filtration is interfered with by alkalies approaching 1 per cent.

Some of the accomplishments of the new filter are as follows:

Removes the color or stain from moorland swampy water.

Produces a colorless effluent from a solution of erythrosin when diluted with 5,000,000 parts of water, and having a brilliant orange color with fluorescent green glint.

Produces from milk a clear effluent, nearly tasteless.

Extracts the oil from feed water.

Separates water and impurities from oil.

Extracts 30 per cent of the salt in sea water.

Decolorizes unrefined sugar.

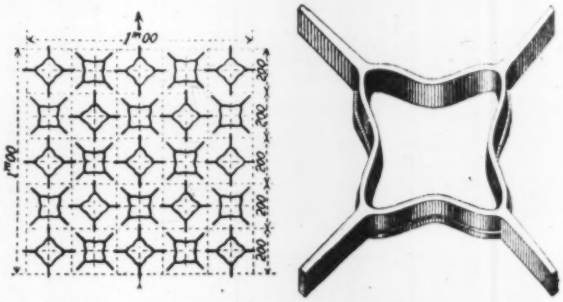
Separates cyanogen from gas house sludge.

Reduces dilute activated sludge to a 60 per cent water content.

It is too early, of course, to say much as to the economic worth of this filter in the industries or to outline the scope of its benefits to science. But the indications are that it will have a bright future along many lines of activity.

Armored Concrete Pavements in France

ISOLATED sections of concrete pavement strengthened against wear by embedded iron castings arranged symmetrically as illustrated, have been tried out successfully in a number of French cities. In constructing this pavement the base of lean concrete is leveled and smoothed with a coat of mortar on which the castings



CAST-IRON UNITS EMBEDDED IN CONCRETE PAVEMENT

are arranged by hand and then filled flush with a rich concrete. The castings, as illustrated, are about 2½ in. deep and weigh about 1¾ lb. each. Their shape is such as to provide quite even distribution of metal in the surface of the concrete. There are about 25 castings per square yard. It is stated that wherever it has been tried this pavement has stood up remarkably well under heavy traffic.

Boating on Hetch Hetchy Reservoir

The completion of the Hetch Hetchy dam in the Yosemite National Park by the City and County of San Francisco for water supply purposes raised the question as to who had control of the renting of boating and other recreational facilities on the reservoir, which will be about seven miles long and have an average width of one-half mile. According to a decision rendered by John H. Edwards, solicitor of the Interior Department, a director of the National Park Service under the supervision of the Secretary of the Interior "has exclusive power to grant any concession affecting the Hetch Hetchy reservoir or the lands appurtenant thereto which will not in any way materially injure the structures of the reservoir, interfere with, or hinder the city's use of it, or in any way pollute the waters thereof."

From Job and Office

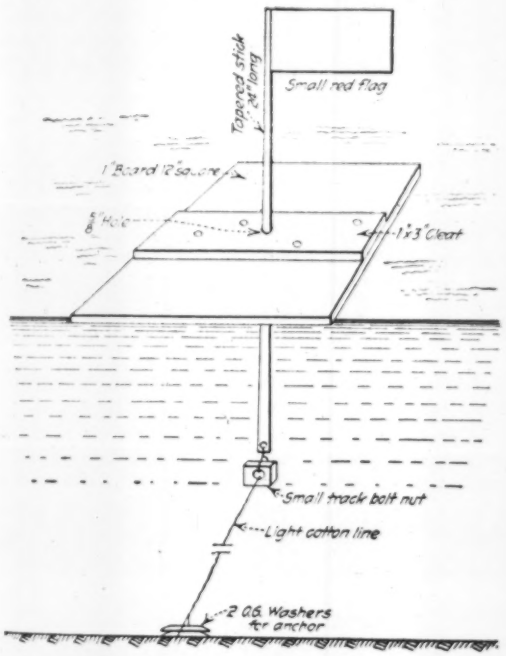
Hints That Cut Cost and Time For the Contractor and the Engineer

Simplifying the Taking of Soundings Under Adverse Conditions

By E. B. Fauntleroy

Engineering Department, Norfolk & Western Ry., Norfolk, Va.

TAKING soundings over a wide area, congested with shipping, where the water is deep and usually fairly rough, is a problem the solving of which may require considerable ingenuity. These obstacles are all encountered at the coal piers of the Norfolk and Western Ry. in the outer harbor at Norfolk, Va. Here a light wind makes navigation in the ordinary skiff uncomfortable; large steamers, tugs and small boats



FLOATING TARGET FOR TAKING SOUNDINGS

are numerous, the tide is strong and water from 35 to 50 ft. deep.

Soundings are taken semi-annually. At right angles to the docks lines are run out at 50-ft. intervals and soundings taken on these lines at 10-ft. intervals up to 50 ft. out; thence every 25 ft. up to about 150 ft. out. The remaining area in front of and between docks, out to and across the channel, is divided into 100-ft. squares at the corners of which depths are measured. Along the docks a light graduated wire on a wooden reel for measuring distances out and a small rowboat serve admirably.

In the much used channel where there is more sea and where waves from passing steamers are bothersome, the problem is difficult. Here it is impossible to stretch a wire for any length of time, and a small boat must be quickly handled to prevent being run down; the tide is unusually strong and the water 40 to 50 ft. deep. To mark points on the range lines a small floating target as shown in the sketch was effectively used, was easily made and could be quickly set and moved. These targets were set from 200 to 600 ft. apart as required and distances measured with a light wire 200 ft. long, using two boats with detachable motors. With this equipment and using fixed points on shore, the intersections of the range lines could be accurately located and the work done with despatch.

Moving 7,500-Ton Office Building to Provide for Street Extension

MOVING a seven-story office building of the Illinois Central R.R. at Chicago is one of the latest examples of the success with which large structures can be transferred from one site to another. The building is on the southeast corner of Michigan Ave. and Roosevelt Road (or 12th St.) and had to be moved 85 ft. south to permit of extending Roosevelt Road to the lake front. This structure, originally the Ashland Block, was torn down and rebuilt on its present site in 1890. It is about 130x80 ft. in plan, with its narrower side on Michigan Ave. and in the direction of travel. At the middle of the rear a court or recess reduces the width to 64 ft. The height is 100 ft. from street to top of parapet wall. Weighing 7,500 tons, it is said to be the heaviest building ever moved.

The building is of composite construction with exterior and interior brick walls, cast-iron columns, I-beam girders and wood joists. The outside walls and interior corridor walls are brick bearing walls, but in the two street fronts the walls do not extend below the ceiling of the first floor, being supported by cast-iron columns standing on stone piers whose tops were in the basement. Cast-iron interior columns in two sections of the building carry steel I-beam girders running lengthwise or east and west. Upon these I-beams are wood joists and wood flooring. Wood frame and composition covering constitute the roof. Originally the column spacing was about 17x20 ft., with the longer spacing north and south. A few years ago the east portion of the building was strengthened, on account of increased floor loading, by the addition of six intermediate cast-iron columns carrying I-beam girders and reducing the panel spacing to 17x10 ft.

Actual moving operations were limited to the period from 5 to 8 a.m. each week day, by order of the South Park Commissioners, so that traffic could be diverted from Michigan Ave. during the operations, such diversion being impracticable for the later heavy traffic on this congested thoroughfare. Moving was begun Sept. 24 and finished Oct. 3. Interior shoring was used only in the first-floor openings in bearing walls, to support the walls above these openings.

Although the distance moved was not great the work was made difficult by the small space available. Since the rear of the building in its new position is only 16 ft. from another structure there was no room for a straight

pull with the hauling cables and these cables had to be led out to capstans placed in an open lot at the east side of the new site. Deadmen composed of steel rails were driven into the ground within the 16-ft. space and to these were shackled steel sheaves giving the cables a right-angle turn. Similar sheaves were shackled to heavy timbers under the building and bearing against the underpinning on which the building was carried. The cables were led to and fro under the building in the usual manner and the free ends were carried across the rear of the building to four two-horse capstans on the east side.

Timber blocking was built up in the usual way on the concrete floor of the basement and wedged tightly

MOVING 7-STORY OFFICE BUILDING IN CHICAGO
View looking west along Roosevelt Road. The building is being moved south for the widening of this thoroughfare. The tall tower in the distance, beyond the elevated railroad, is one of the connecting towers for the long Roosevelt Road viaduct, crossing railway tracks.

against the building, which was supported by needle beams resting on lines of stringers along both sides of the walls and columns. Several of these stringers were timbers 20x20 in. in section and 90 ft. long. Steel plates under each stringer rested on steel rollers riding on four lines of steel rails carried by the blocking timbers. Ordinary building jacks or screw jacks were used to take the load when separating the building from its foundations. After cutting the brick walls and cutting the cast-iron columns below the first floor level by means of torches, the building was ready to be moved. New concrete foundation walls and spread footings for the columns were built in advance on the new site, the walls being carried 3 ft. above basement floor.

In addition to the main movement to the south, the building had to be moved 6 in. westward to adapt it to the revised building line of Michigan Ave. This lateral movement was effected by placing the rollers at a slight angle across the lines of rails, so that for part of its travel the building moved diagonally or southwest. After the building reached its final position, a brick wall was built on top of the concrete wall between the large timbers and when the masonry had seasoned the weight was transferred to these piers by jacks, the timbers being then removed and the wall completed.

The moving of this large building was planned and directed by the Chicago Terminal Improvement organization of the Illinois Central R.R. of which Daniel J. Brumley is chief engineer. The work was carried out by W. H. Brown & Co., Chicago, with Hugo Filippi as engineer and superintendent in charge.

From Job and Office

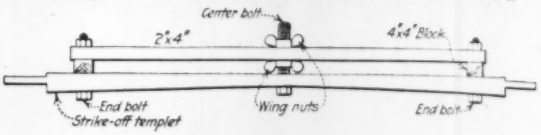
Hints that Cut Cost and Time

Pavement Warped by Adjustable Templet

BY PAUL L. FETHERSTON
Jackson, Michigan

AN ADJUSTABLE templet, similar to the one shown in the cut, can be used successfully in warping the surface of a concrete pavement. This templet can be made by placing a 2 x 4-in. timber over an ordinary split strike-off templet. The ends are raised from the templet by means of 4 x 4-in. blocks and securely bolted in place.

A center bolt is passed through both the templet and 2 x 4 and secured to the former by means of a nut. Wing nuts are placed on the bolt above and below the 2 x 4.



ADJUSTABLE TEMPLET FOR CONCRETE PAVEMENT

The camber of the templet should be about one-half of that required to produce a pavement surface of the normal crown. Then by depressing the wing nuts the 2 x 4 will be drawn down and the templet upward till the desired camber is produced.

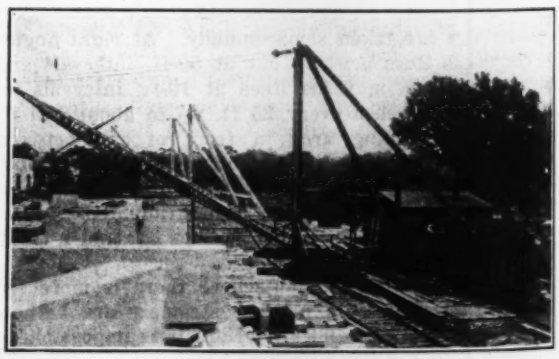
On going into a superelevated curve or in any instance where it is desirable to alter or eliminate the pavement crown, the wing nuts are gradually turned upward as the templet is moved forward over the fresh concrete. The two members are thus forced apart and the camber of the strike-off is slowly eliminated.

This brace also serves to hold the templet rigid at all times so that its use insures a more even surface than can be obtained with an unbraced templet which tends to be slightly flexible.

Movable Derrick-Crane Economizes Space

BY DALE R. VAN HORN
Walton, Nebraska

UPON the site of the new Nebraska state capitol building are being used two specially-constructed traveling cranes, which are a combination of stiff-leg derrick and gantry crane. The cranes were built practically entirely on the job.



BUILT-UP CRANE ON NEBRASKA CAPITOL BUILDING

From Job and Office

For Contractor and Engineer

When material handling became an acute problem on the work, recourse to some sort of traveling crane with a long lifting radius was necessary. The usual gantry type, with distance between crane rails of 40 ft., could not be used because that spread between rails was not available. Also, space between rails had to be used to some extent for storage purposes. The stiff-leg derrick type was decided upon, but a type which allowed free movement to all parts of the job. Accordingly the crane herein herein pictured was built.

Deadweights to counteract the pull of the boom are provided on two sets of trucks loaded with stones and earth, and built up as timber cribbing. The weight of each deadweight is about 30 tons, and the distance between the two deadweights is 62 ft. This distance allows the hoisting engines to be set between the deadweights, thereby economizing space. The distance between crane rails is 26 ft. and the tracks are high enough so that a great deal of storage space for steel, timber and other materials is provided between tracks.

The boom of the crane is 106 ft. long. Inasmuch as the crane tracks entirely circle the site of the new structure, which is about 435 ft. square in plan, the cranes give a wide range of usefulness. The cranes are driven by 40-hp. steam engines.

Reclaiming Heavy Plate Girders

By J. C. Lamon

ON A LARGE hydro-electric construction job on the Little Tennessee River one of the railroad bridges was carried out in a flood. Owing to the difficulty of replacing the wrecked steelwork, it was decided to reclaim the bridge. These huge steel girders—68 ft. in length and 6 ft. high, of heavy plate construction—though badly distorted, were reclaimed by ordinary blacksmith methods.

PLATE GIRDERS BEFORE AND AFTER STRAIGHTENING

After the wrecked bridge had been hauled out of the water by powerful cranes, the girders were transported to a yard equipped with a 50-ton derrick and sidetracks. Heavy I-beams were laid at regular intervals, and the girders were placed on them with the mid-point of the sag in the girder directly over an I-beam. Then the girders were heated, slack coal, coke and crude oil being used. A long heat was taken at the apex of the sag; the heat was confined by packing slack coal on both top and bottom of the plate. Heavy pieces of coke were placed on both sides of the narrow section of the girder, and with the aid of two powerful blow-torches with air pressure of 90 lb. a slow heat was taken. When the plates were sufficiently heated, the girder was allowed to sag of its own weight until straight at the particular point. This operation was repeated until the entire girder was gone over. The crane, with a sling, held the girder so that it would not be bent concavely. When straightened, it was blocked or jacked. At some stages of the work it was necessary to use both derrick and locomotive crane.

Flattening of the flanges and cover plates was accomplished by ramming with an iron rod 6 in. in diameter and 20 ft. long swung from the derrick.

Where the heats were taken, rivets were, of course, loosened, so they were cut out and new rivets were driven.

All-Year Railway Painting Program

THAT it is entirely practicable to arrange a railroad painting program covering the entire year, which will result in more efficient and economical work and will enable the railroads to retain their best men as a permanent force, is the conclusion of a committee which reported at the recent annual convention of the American Railway Bridge and Building Association. An abstract of the report is given below.

The general understanding has always prevailed that railroad buildings, bridges and other structures should be painted only during the summer months and therefore it is established practice to organize painting crews in the spring and disband them in the fall. Thus each year the railroads face the problem of finding new painters and in most cases must take on new and inexperienced men and train them. In a measure the railroads become the training school for the local contractors and lose much in economy and quality of work.

The question is: Can a program of work be so planned as to give painters work all the year round? The answer as developed by the investigations of this committee is in the affirmative, and it is being done successfully on some railroads. Outdoor painting can only be done when weather conditions are favorable, but such work as can be protected from the weather or is indoors may be done at any time.

Painting steel bridges is, for the most part, limited to the months of June to September, inclusive, although further south this period is extended. The painting of other steel structures such as tanks, turntables and signal bridges is also limited to about the same period, but the season for painting wooden buildings and structures is somewhat longer as the work may be done both earlier and later in the year. The remainder of the year may well be named the indoor season, and during that period any class of interior painting or the painting of objects that may be brought under shelter may be done. It may be well to note the practice on the Grand Trunk System, as reported by

George A. Mitchell, Superintendent of Bridges and Buildings:

"The practice which has been in force on my territory (something over 2,000 miles) for a number of years has enabled me to maintain a regular force of painters during the entire year. During June, July, August and September our painters are wholly employed in painting steel bridges. During April, May, October and November, and some seasons the fore part of December, they are employed in the exterior painting of buildings. The balance of the time they are employed in painting and decorating the interiors of our buildings. Therefore the work is so distributed in this northern country that we are able to employ our painters the entire year and consequently we have men in our service for many years who become accustomed to and skilled in our particular work."

A painting program could be outlined which would permit the employment of an average crew on a division during the entire year, with the addition of a few men during the outdoor season when there is an unusual amount of bridge painting to be done. The painting crew is equipped with light rigging, easily handled, that will save the expense of building scaffolding and enable the men to make many minor repairs.

Another feature worthy of serious consideration is that painters are good mechanics and are capable of doing other work more economically than crews sent specially for that purpose. For instance, a painting crew working at a station could replace broken glass, take down stove pipes in the spring and clean, paint and store them. They could clean out gutters and conductor pipes and paint them before they begin to rust. In the fall they could take out window screens, clean and paint them, and put them away.

Renewing Railroad Culverts

REBUILDING old culverts, putting in new drain pipes and culverts and replacing old box culverts with pipes is a class of work continually required in railway maintenance, and the following particulars of such work are abstracted from a report of the American Railway Bridge and Building Association:

Trenching—In unstable soil where a temporary opening must be made in the fill, pile bents may have to be driven, sheeting being placed behind them to support the sides of the trench. Piling should be driven only when absolutely necessary, on account of the increased cost.

Where an open trench is used for small pipe it is advisable to transfer the track support to some distance on each side of the trench. One method is to place a 6-ft. length of second-hand bridge stringers flatwise under the ties, under each rail. The trench should also be cross-braced with trench jacks. The Pennsylvania R.R. places a track rail under the ends of the ties, with the head up, and immediately over it another rail on top of the ties, fastening the two rails together with clamps. This provides a strong support at minimum expense, as extra rails are usually available. Where ties are not supported on account of trench excavation, the Illinois Central R.R. places a rail on each side of the traffic rail with hangers that pass under the latter rail and over the extra rails.

If the pipe is large or if two or more pipes are placed side by side, an approved method is to dig a narrow trench under the track at each end of the section to be excavated, set up frame bents and support the track on stringers placed under the track ties. This is a good method to use when removing old or broken culverts.

Tunneling—When the height of the embankment is too great for an open trench it is necessary to drive a tunnel, or the trench method can be used for the ends and the tunnel for the portion under the tracks. One method is to excavate carefully to the proper dimension and place timber or plank sets as the excavation proceeds, placing the mud sill and top first and while holding the top in place with a jack, place the side pieces, after which a strip should be spiked to the top piece to keep the sides from crowding in. Another method is to excavate 3 or 4 ft. wide, set up frame bents and drive lagging over the top of the bents. As only a small force can be worked in a tunnel it is advisable to work from both ends. Tunnel work can be handled best during the winter season. Where small pipe lines pass under several tracks, it is often advisable to sink shafts between the tracks and tunnel under the track between the shafts. If the ground is firm it is often possible to tunnel between shafts without using any supports if the pipe can be placed at once and the backfilling is tamped into place.

Boring and Jetting—On the Southern Pacific Ry. water and gas pipes up to 3-in. in diam. are tunneled through earth embankments with a dirt auger and if sufficient water pressure is available they are jetted through in the same manner as jetting piles.

Chicago, Milwaukee & St. Paul Ry.—We are placing 24 to 48-in. concrete pipe inside of timber culverts 36 to 300 ft. long under fills 6 to 125 ft. in height. Regardless of the size or length of pipe, we slide it into the culvert on a skidway that extends all the way through, and far enough outside to enable the pipe to be rolled onto it. The skidway is made of 2x4 or 2x6-in. timbers with chamfered edge, laid 8 in. apart for 48 in. pipe and a little closer for smaller pipe. The skids, spiked to the bottom timbers of the culvert. They are well greased in warm weather, and in freezing weather they are made wet to form ice. For pipe with bell ends a hardwood shoe is placed under the spigot end to raise it level with the bell end so as to prevent the sharp edges of the pipe from cutting into the skids. Except for the largest pipes we seldom use block and falls as the pipe moves easily on the greased skids. With a crew of eight men we average 50 to 60 ft. of 42-in. pipe, placed, backfilled and tamped per 8-hour day. We haul the backfilling material in a box on runners made to fit the skidway.—T. E. McFadden, Cedar Falls, Wash.

New York, New Haven & Hartford R.R.—We recently renewed a culvert under a single track section over which 29 trains operate per day, located about ¾-mile from the nearest siding where a work train was enabled to clear regular trains. The fill is about 10 ft. high. The culvert carries a small brook and tidewater which interfered considerably with the progress of the work. As the fill was of granite riprap, piles could not be driven; therefore the track was supported by 3-ply 15-in. I-beams 24 ft. long under each rail, which in turn were supported by four 12x12-in. hard pine underlays.

The stone fill was cut by means of hand drills and wedges, and the sides of the excavation braced as the excavation proceeded until a depth of about 11 ft. below base of rail was reached. When the excavation was completed the I-beams were removed and five lengths of concrete pipe were installed by use of a derrick car. Then a sufficient backfill was made to carry the track. This work was done between midnight and 5 a.m. as this was the longest period in the 24 hours during which the track was unused.—E. E. Candee, Waterbury, Conn.

New York Central R.R.—A small stone box culvert which had failed, was replaced with a 42-in. cast iron pipe culvert, 156 ft. long, and 31 ft. deep, under four main tracks. It was necessary to take out the stone of the old culvert, and tunnel through the bank, using 8x8-in. timber frames for a tunnel 5 ft. square. After the tunnel was completed, we put in the first near the middle and backfilled over it, ramming the material in tight. Then, another pipe was drawn in from each end, and connected to the first pipe and material backfilled over each of them, and rammed tight, so that we had a tight culvert, with no place for water to run through outside of the pipe and cause trouble.—R. H. Reid, Cleveland, Ohio.

Delaware, Lackawanna & Western R.R.—We had to renew a timber culvert carrying a double track passenger

From Job and Office

Hints that Cut Cost and Time

From Job and Office

For Contractor and Engineer

line over three pipe lines supplying water to Jersey City. The pipe lines consisted of 36- and 24-in. cast iron mains and an old 30-in. brick conduit, all supported on timber grillage on piles. The tracks carried about 150 movements in 24 hours. Tho soil was 12 ft. of black mud over clay subsoil. The pipes were about 2 ft. apart and the top of the brick conduit was not more than 18 in. below base of rail. A highway prevented track diversion on the east side and a steel viaduct carrying an electric line over the railroad prevented a double track diversion on the other side. Further there was not space above the pipes to support the track on falsework and leave room for the new reinforced concrete slab.

It was necessary to locate a single track detour for westbound trains and carry the eastbound traffic on a gauntlet track laid on the same ties, thus avoiding the throwing of switches. Train movements were protected by flagmen at each end of the detour with hand-operated home and distant signals. This arrangement permitted the old track to be used in driving the piles to support the new structure and for unloading concrete material. It also resulted in a minimum delay to trains.—F. L. Wheaton, Buffalo, N. Y.

Job and Office Notes

Further Experiments With Rubber Paving Blocks are being carried out in Britain. A street in Manchester is being paved with rubber, the traffic passing over it daily being around 9,000 vehicles and some 1,000 tramcars; the total weight being estimated at 15,000 tons. Instead of the usual method of employing small blocks as in wood paving, large slabs of rubber weighing 600 lb. each will be used. The slabs are reinforced by steel bars in order to prevent the creeping of the rubber, and each slab is secured to the next by steel pins. Creeping is one of the troubles to which rubber roadways are liable. As showing the extent to which they can be moved it may be said that a five-ton vehicle passing over a surface of rubber blocks will spread them half an inch. The slabs will be laid on a concrete foundation, to which they will be attached by a bituminous compound which is impervious to water. The surface of the slabs are corrugated, to give the appearance of small blocks, and thus affords a safe foothold for horses. In addition, the slabs are reinforced at intervals with steel bars, which keep them rigid while retaining the necessary pliability to insure noiselessness.

Inspection of the Formula for Solving vertical curves given in *Engineering News-Record*, Sept. 13, p. 443, "indicated the familar parabola," writes H. S. Martin, of Cope Rand Means Co., Engineers, San Francisco. "I computed the point of elevations for the complete curve by the method outlined," he continues.

"The result was a series of point elevations that bore no resemblance to a vertical curve connecting two tangents, and when platted, a line drawn through them crossed the forward tangent produced between 11 + 50 and 11 + 75 and got back to 12 + 50 only by exceeding the grade of the following tangent for the last two chords. I then extended the forward tangent back to 10 + 00 which gave a new value to *D* of 5 ft. instead of 7.5 ft. Computing in the reverse direction I obtained an entirely new series of point elevations, equally in error but not so conspicuous when platted. The fault, however, does not lies in the formula but in the application, or at least in the apparent assumption that it can be applied to locations having unequal tangent distances. If the curve is properly located, i.e., with the P.C. and P.T. established at points equi-distant from the grade vertex, the formula will give a true parabola from either tangent. In the example illustrated *D* would have its true value of 6.25 ft. for a curve of 250 ft. long and of course be the same from either tangent. I see no advantage in the given formula for working from one tangent over the essentially same one from both tangents. Errors in numerical work are not easily discerned in either. For universal application I prefer to establish the P.C. and P.T. elevations from the tangents and then compute from one to the other along the curve, for the chord points, by the rate of grade change method and thereby secure a check on the computations. This is also, I believe, the least tedious method when grade rates and elevations have several decimals; conditions very frequent in rectification of grade work."

Liquid Oxygen Explosive Has Been Successfully Used in Colorado by the Department of the Interior in experimental mine blasting and road construction work at a cost of approximately one-half that of the gelatin dynamite required to do the same work. The experiments were conducted by E. D. Gardner, mining engineer of the Bureau of Mines, in co-operation with a representative of the Compressed Air Corp. A liquid oxygen explosive consists of gas black, wood pulp or some other carbonaceous material made up into cartridges and soaked in liquid oxygen. This explosive can be detonated similar to ordinary dynamite with cap and fuse or with electric detonators. The liquid oxygen was obtained from a plant designed to furnish oxygen gas and was shipped to the point of use in dewar flasks, which are made on the same principle as thermos bottles. The first Colorado tests made by the Bureau of Mines were conducted with cartridges made in Germany, but later cartridges manufactured at less cost in Denver proved very much more satisfactory. As the use of this explosive is new in this country, numerous tests and experiments were necessary to find a low-priced carbonaceous material which would have the desired qualities and to learn the technique of blasting with this new material. Hand steel holes were blasted in granite on a road construction job above Idaho Springs, with results similar to those obtained with 40 per cent gelatin dynamite. Trees were also cleared from the right-of-way and a 200-ton cliff blasted down successfully. Instantaneous electric detonators and blasting battery were used for this work and no misfires occurred and no holes failed. Disregarding express charges on the oxygen, the cost of liquid oxygen was about half that of gelatin dynamite.

It is Almost an Axiom Among Paving Contractors that industrial outfits are not adapted to grades in excess of 4 per cent, and frequently contractors owning industrial outfits have been unable to bid on work due to the existence of steep grades. C. M. Hathaway, engineer of construction, Illinois Division of Highways, Springfield, Illinois, recalls one instance wherein a contractor operated his industrial outfit on a "down grade" of 6 per cent for a distance of about 1,000 ft., this grade being located a short distance from the unloading plant so that all trains were compelled to make the grade while loaded. In this instance the contractor had suffered a wreck on account of his train running away, whereupon he contrived a rather novel device to protect himself from further accidents. An ordinary block pulley was installed at the top of the hill and held in place by means of a deadman anchored in the roadside, and a wire cable running through the pulley was attached to the rear end of the train descending the hill. The other end of the cable was attached to a motor truck at the foot of the hill and as the loaded train descended, the truck was automatically drawn up, acting in the nature of a counterweight. At the same time the operator of the truck kept his engine running in order that he might produce additional resistance by throwing his engine in gear, if necessary. The scheme was very simple and effective, and in addition the truck pulled the cable back to the top of the hill for another train load as soon as disconnected from the descending train.

Letters to the Editor

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

Earth Dams Require Study

Sir—The failure of the Apishapa Dam, concerning which there has been considerable comment in recent numbers of *Engineering News-Record*, may not have been in vain if it results in the giving of more attention to a careful selection and study of materials to be used in earth embankments.

You have already favored me by publishing in your issue of March 1, 1923, a brief reference to work which the Division of Agricultural Engineering of the U. S. Bureau of Public Roads has been endeavoring to undertake. I say "endeavoring," because the co-operation that has materialized from engineers generally up to the present time, excepting the engineers of the U. S. Reclamation Service, has been very disappointing, only two or three even expressing any material interest in the subject.

It is interesting to note that practically every engineer constructing earth dams who has replied to letters addressed to him upon the subject has taken the position that the dam which he himself was constructing was so well designed that there could be no doubt as to its absolute security and it was therefore unnecessary to make further investigations, possibly forgetting that data regarding the perfect dam are the data most desired. It is also interesting to note in this connection the fact that no two of such dams referred to have been even closely similar in design. In no instance that has been called to my attention, moreover, has any critical study been reported to me as having been made of the soluble matter contained in the soils, the best and most efficient moisture capacities of the soils, the expansion or shrinking of the soils when exposed to alternate saturation and drying out under normal storage conditions, the most effective mixture of earth materials available in a given locality, or of a number of other studies that ought to be made in so important a matter; nor has any provision been made, so far as I am informed, for a study of percolation through, or of the hydraulic pressure under, any earth dams that have been built recently or are to be built in the near future, excepting in one instance.

A long experience with and rather careful study of the problems involved demonstrates to me that even in connection with minor structures, such as backfilling earth for headgates, flume ends, and in the construction of small dams as well as large ones, different soils must be treated in very different ways. Some soils must be thoroughly saturated and rammed into place, practically puddled, while others are most satisfactory with what is known in soil studies as the field carrying capacity of moisture. It is such studies as these that it was, and still is, although somewhat less optimistically, hoped that the Division of Agricultural Engineering, as referred to above, might be able to study in detail.

Permit me to direct your attention to a very valuable article on this subject, written by Dr. Alex L. DuToit, geologist, entitled "Some Experiments Upon the Contractions of Soils in Application to Earthen Dams," which appeared in the July, 1923, number (Vol. 2, No. 3) of the South African Irrigation Department Magazine. The author calls particular attention to the complicated nature of the questions that may arise in excessive wetting, and the subsequent shrinkage, of soils, particularly those of a clayey nature, and gives us the results of some investigations that have been made in the West Indies, on a limited scale.

So far as I have been able to discover in studying the details of construction of the Apishapa Dam, no careful studies were made at any time of the proportion of soluble elements contained in the soil, of its optimum moisture content, of either the co-efficient of expansion or shrinkage under varying conditions, or by making of any analysis, either chemical or physical, to determine what, if any, commingling of the soils to be used was needed. In the construction of a concrete or masonry dam, the cement, the sand, the gravel and the water, and combinations of these ingredients of the concrete, are studied with the utmost care. Such study is fully as important, perhaps even more so, in the study of the earthy materials of which it is planned that a dam shall be composed. The fundamental trouble is that in the construction of a masonry dam, the fact is recognized that an *experienced* engineer, reasonably well paid, should have charge, but in the case of an earth dam it is assumed that any one who can run a level is competent to direct, whether he has ever before had anything to do with such a structure or not.

It is my opinion also, based upon my study of a number of earth dams that have failed, and also of many dams showing no signs of failure, that no dam, the failure of which could in any way endanger the public safety or welfare, should be permitted to be constructed without requiring that all possible safeguards, such as have been mentioned herein, be thrown around it by those in authority.

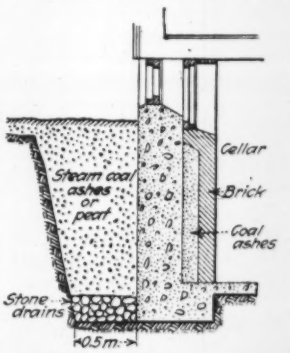
Denver, Colo.,
Oct. 3, 1923.

A. LINCOLN FELLOWS,
Senior Irrigation Engineer,
U. S. Department of Agriculture.

Action of Frost on Foundations

Sir—I have seen your article "Action of Frost in Heaving Concrete Piers" in *Engineering News-Record* for Aug. 30, 1923, p. 360, wherein is described one of the many cases in which frost has shown its bad influence on engineering works.

It may be of interest to you and some of your readers to hear that in Sweden, and especially in its northern parts, where the frost penetrates one or two meters in the ground, we insulate almost all foundations of houses, retaining walls, etc., by means of such materials as steam coal ashes, peat and so on, which have small capillarity and heat conducting power. In this way it is possible to avoid the heaving of subsoils which are sensitive to frost. Without such precautions the water-soaked earth filling will adhere strongly to the foundations, as if the whole were one solid block, which would irresistibly follow the physical law that frozen water takes greater volume than unfrozen. If such an insulation had been arranged around the described pier and an ordinary drain had been laid down at the bottom, the heaving should never have occurred.



The sketch shows the method of insulating the foundation of a house in northern Sweden.

If you are interested in the above question I may also refer to my report, No. 8, at the international highway congress in Seville this spring, in which report I have tried to treat the question of the influence of frost on the highways. There you will also find some notices about our insulations of the railway tracks in northern Sweden.

In reference to the intricate question of highway construction I am almost convinced that it will not be brought to a satisfactory conclusion until we highway engineers have succeeded in deeply penetrating the secrets of the frost action.

GUSTAV DAHLBERG,
Civil Engineer

Stockholm, Sweden,
Sept. 20, 1923

News of the Week

CURRENT EVENTS IN THE CIVIL ENGINEERING AND CONTRACTING FIELDS

News Brevities

A Civil Engineer Degree at the Age of 81 years was the unusual record of Frank L. Weaver, who in 1871 found it necessary to leave the engineering class of the University of Kansas and go to work and who in 1922 went back and took up his unfinished course with the result that on Oct. 1, 1923, he won the degree of B. S. in civil engineering from that institution.

Canadian Road Construction Expenditures of $15,000,000 are reported for this year's season ending Nov. 15, the Dominion government contributing 40 per cent of this. Up to the end of April last a total of $11,350,000 of the $20,000,000 federal highway grant had been paid out, and this year's payments will be about $4,000,000 additional.

Preliminary Work Is Being Rushed on the Island Falls power project of the Hollinger Consolidated at Timmins, Ontario. The work will require a spur line from the northerly extension of the Temiskaming and Northern Ontario Ry. Contractors are already engaged in clearing the right-of-way and clearing the site preparatory to the commencement of excavation.

Work on the Power Structures at Muscle Shoals is 60 per cent complete. Due to the favorable season, great progress was made during September and October. On Nov. 1, 630,000 cu.yd. of the concrete work had been completed. In all, 1,300,000 yd. of concrete must go in. While only half of the concrete work has been done, the job is more than 50 per cent complete since all the cofferdams are in, all of the plant installed and all of the construction buildings completed.

Electrification of the State Railroad between Stockholm and Goteburg is to be undertaken at an estimated cost of 6,000,000 crowns ($1,578,000). The Swedish State Railways estimate the amount needed for new construction work during the ensuing fiscal year at 15,800,000 crowns ($4,154,400) which includes the electrification project and also includes expenses for a number of operations for which funds already have been appropriated. The amount of new appropriations needed is about 9,000,000 crowns ($2,367,000).

Repair Work on the 100 Miles of the Alaska Railroad damaged by high tide and heavy storms that put the line out of commission has proceeded to such an extent that traffic has now been resumed. The two large bridges that were washed away near Spencer Glacier and Bartlett Glacier have been replaced by temporary pile bridges and the washed-out embankments and cave-ins have been reconstructed. In order to prevent the congestion of freight due to the suspension and delay of traffic a regular weekly boat schedule to Anchorage has been arranged.

U. S. Reclamation Service Further "Reorganized"

A new order by Secretary of the Interior Work on Nov. 6 changes the administrative system of the Bureau of Reclamation (the former Reclamation Service) by removing the operation of the projects from engineering direction. After Dec. 1 the chief engineer of the bureau is to confine the work of his office to investigation of proposed projects, design and construction, while operation and management of the projects is to be in the hands of a field commissioner. The present field commissioner is Miles Cannon, a politician. F. E. Weymouth is chief engineer. Statements given out by the department claim that the change with the elimination of an assistant commissioner and the assignment of the photographic laboratory to the Geological Survey will save $10,000 a year in salaries.

New Railroad Across the Niagara River

The American Niagara Railroad Corp. has been authorized by the Interstate Commerce Commission to construct 10.36 miles of track from a connection with the New York Central in Tonawanda to the international boundary where it will connect with the Canadian Niagara Bridge Co. which has been authorized by the Canadian government to construct a line from the international boundary to connect with the Canadian Pacific Ry. The cost of the new line, including the double-track main line and yards, is estimated at $18,000,000. It is to be owned jointly by the New York Central Railroad Co. and the Canadian Pacific Railway Co., the New York Central holding the majority of the stock.

Denver Water-Works Program of Construction

Plans for the following major improvements provided for in the recent bond issue are being prepared by the engineering department of the Denver Board of Water Commissioners: Relining and covering Ashland reservoirs, $100,000; building a 66-in. conduit from Marston Lake to the city, $840,000; constructing filters on the north side of Marston Lake, $1,250,000; extension of a 60-in. pipe line from Kassler to Marston, $750,000; extension of a 54-in. pipe line from Massey Hill to Wynetka, $450,000; increasing the efficiency of the slow-sand filters at Kassler, $500,000; total, $3,890,000.

Late in October the board authorized additional large distributing mains in the city estimated to cost nearly $750,000. Work on these mains will proceed with all possible speed, according to an official bulletin of the board.

Earning accounts for 1922 totaled $1,906,375. Operating and maintenance expense was $755,827, and interest on bonds was $639,799 leaving a balance in net income of $510,749 expended in capital improvements and extensions.

Sewage Plant Operators of Iowa Discuss Problems

Operation and Maintenance of Septic and Imhoff Tanks, Filters, Pumps and Siphons

More than fifty sewerage-works operators and others interested attended the fifth conference of Iowa operators on sewage treatment problems held Oct. 22 to 24 at Iowa State College, Ames. Septic tanks, Imhoff tanks, sand and sprinkling filters, each came in for a session with special papers on siphons, pumping stations and sludge handling. After a subject had been presented by a series of papers, C. H. Currie, consulting engineer, conducted a question-and-answer discussion.

H. V. Pedersen, state sanitary engineer, opened the conference with a statement of the present status of stream pollution and efforts to abate it by the 191 plants in the state, serving a population of 325,000. About 30 per cent of the domestic sewage of the towns having sewerage systems is treated to a non-putrescible state. Aside from the Des Moines and Cedar Rivers the rivers within the state are short and small. They are so polluted as to make bathing dangerous and fish life impossible. Mr. Pedersen held (1) that there is a growing sentiment demanding that streams be kept fit for bathing, (2) that to do this definite limits of pollution must be set, (3) that public opinion must back up the department intrusted with the duty of setting the limits and seeing that they are not exceeded and (4) that the Legislature must provide the necessary organization within the State Board of Health.

Following this paper J. J. Hinman, Jr., chief of the water laboratory division, Iowa State Board of Health, indicated the relation of sewage treatment to water supply.

Septic Tank Problem

Prof. C. S. Nichols, Iowa State College, presented the septic tank problem, giving first a resume of its history, design limits and what a tank is supposed to do. He emphasized the point that any tank is only a preliminary process as it can be expected to handle but one-third of the soluble organic matter which is usually but one-half of the total amount, the remainder being solid matter.

Prof. Earle L. Waterman, Iowa State University, in his treatment of Imhoff tank practice, stated that there were 6[illegible] Imhoff plants in Iowa and 80 per cent of all those being designed were of the two-story type. After noting design features he gave a schedule of operations which include (1) daily cleaning of screens and grit chambers, (2) weekly cleaning of sides and bottoms of settling chambers, (3) removing floating material from settling chamber, to prevent septic action, (4) equalizing sludge deposits, (5) breaking up scum on gas vents, (6) observing depth of sludge, drawing and drying it. Difficulties arising from inefficient operation

are septic action in settling chambers, clogging of slots and sludge pipes and foaming at gas vents. If the schedule is followed Prof. Waterman held that the troubles would be largely eliminated.

Stanley Pinel, Engineering Extension Department, Iowa State College, in discussing the disposal of sludge, was optimistic as to its use for fertilizer by farmers. One operator indicated that he had no difficulty in getting Imhoff sludge taken away and contemplated making a minimum charge which he thought would make the sludge even more sought after.

Dr. Max Levine, Iowa State College, has been working on creamery wastes and finds that they can be handled by the activated-sludge process but it requires 50 to 60 cu.ft. of air per gallon and 6 to 12 hours' time. This, however, is not impracticable for the amounts are usually not large. An operator of a much-complained-of creamery plant at Sioux Center outlined his troubles. Undoubtedly he will soon be blowing air through his wastes, thus benefiting directly from the conference which brought the results of experiments to him.

Lafayette Higgins, consulting engineer, outlined trickling filter practice, largely by a description of the two-year old plant at Indianola. Major Edward D. Rich, chief engineer, Michigan State Board of Health, did the same for sand filters by a résumé of the operation of plants in Michigan. Aside from private plants for institutions there are 31 sewerage-works of all kinds in Michigan, the present status and operation of most of which were described by Major Rich. Cultivation or hand raking to overcome clogging of sand filters seems to be standard practice.

The last day's program consisted of a laboratory demonstration of ordinary plant tests and an inspection of the treatment plants for the college and town.

"Design, Operation and Care of Pumping Stations" was the title of a paper by C. S. Timanus, with Burns & McDonnell, consulting engineers. L. E. Rein, of the Pacific Flush Tank Co. in his talk on siphon troubles, said 90 per cent of them were due to air leakage. Soap and a shaving brush were the handiest tools to test for leaks.

Ten North Carolina Road Contracts Let

On Oct. 10 the North Carolina State Highway Commission let contracts for ten projects, upon which 97 bids were submitted; the projects composing three bridges and seven road jobs. There were 57.02 miles of roads let, costing with the bridges included, $1,336,582, exclusive of the usual 10 per cent for engineering and contingencies. Of this mileage, 19.9 miles were of standard concrete surface, and the average cost per mile was $33,406.53 which included grading, draining, paving, reinforced-concrete bridges and culverts and all other items of construction; 7¾ miles of this pavement were 18 ft. wide and the remainder was 16 ft. in width. Of the remaining mileage 37.12 miles were of earth, or topsoil construction and cost $11,005 per mile. The bridges and culverts cost $433,364 of which one bridge over the Cape Fear River cost $204,201.

Birdseye Party Successfully Surveys Grand Canyon

Col. C. H. Birdseye, chief topographical engineer of the U. S. Geological Survey, who led a party of engineers reported in distress while making a survey of the Colorado River, at a luncheon given Oct. 29 in Denver by the Denver chapter of the Colorado Society of Engineers, described the survey trip as follows:

"We knew nothing of the worry of the outside world, until we reached Diamond Creek Oct. 3. Here we were handed copies of newspapers and saw that the whole thing had been greatly exaggerated. We never had a boat bearing the initials U. S. G. S., therefore we cannot say anything about the empty boat found floating bearing those initials. On Sept. 19, the night the flood started, the party was camped just above Lava Falls in the Grand Canyon. We were forced to move camp several times, the water rising 18 in. an hour, the total rise in the 24 hours being 21 ft."

The trip consisted of 455 miles. There were four boats in the party, and when the water was at flood stage they made between 35 and 40 miles a day. Twenty-five rapids were encountered in Marble Canyon, while ninety rapids of major size were found in the Grand Canyon proper. Previous to the flood the party was in touch with the outside world, by wireless, the principal points heard were Los Angeles, Denver, Colorado Springs and Chicago.

Regretting the worry caused, Colonel Birdseye admitted that while so many were worried the party was peacefully at work making the necessary surveys. The work started at Lees Ferry, Ariz., in August.

All Because of a Broken Main

THE photograph herewith shows what happened when a water main, under heavy pressure, broke in Wilmington, North Carolina. M'Kean Maffitt, superintendent of public works, sends in the picture with these words: Broken water main under 100 lb. pressure; a washout; a Ford; a splash; no damage.

Failure of Morris Canal Bridge Caused by Collision

Further investigation into the cause of the failure of the Morris Canal bridge at Garrison Ave., Jersey City, N. J., reported in *Engineering News-Record*, Oct. 11, 1923, p. 614, has revealed that thirty-five minutes before the bridge collapsed under a truck which with its load weighed over 14½ tons (the load limit was plainly marked as 8 tons), another truck had collided with the end post of the center truss, damaging both it and the truck.

The end post was of cast iron, octagonal in section, its lower end encased in masonry close to the edge of the bridge seat, and its upper end forming a cap on which the main shoe of the truss rested. The truss apparently was not bolted or fastened to the end post in any way so that in case the end post received a heavy side blow the support of the truss would be destroyed. All evidence points to this as being exactly what happened; the first collision damaging the bridge up to the point of failure.

The time of the accident was at noon on October 2 and not at midnight as previously stated.

New Joint Sewer District Formed in Los Angeles County

More than a dozen towns and small cities in southern California, between Los Angeles and the ocean, are planning to obtain an adequate sewerage system through the formation of the South Central Metropolitan Sewer District. A large number of property owners have signed a petition calling upon the county supervisors to create a sanitation district for the area involved, under the provisions of Assembly Bill No. 191 passed at the last session of the legislature.

This act authorizes the formation of certain joint sewerage districts and the issuance of district bonds under the direction of a board of directors composed of the mayors of each city involved, and at least one county supervisor, which board has authority to employ engineers.

In the district involved sewer systems serve less than one-third the present population and the move underway has two primary objectives, namely, "(1) to protect public health from cesspool conditions which are rapidly becoming alarmingly serious and (2) to prepare the district for a large increase of population."

On the basis of cost alone, it is stated in literature urging the move, the sewerage plan is justified because the "30,000 active cesspools represent an annual outlay [operating expense?] of $500,000 which would retire the interest and sinking fund on an investment of over $8,600,000. Such an amount would more than pay for a comprehensive sewer system to say nothing of saving vast sums in the future."

After a hearing before the board of supervisors the next procedure would be the organization of a board of directors and finally the holding of a bond election. The district as now being formed includes Compton, Watts, Willowbrook, Huntington Park, Maywood, Monterey Park and other communities.

North Jersey Moves for Joint Water Supply

Wanaque-Ramapo Development of 150 m.g.d. May Be Required—Talk of Buying All Private Companies

At a hearing held by the North Jersey District Water Supply Commission at Newark on Nov. 1, the fact was brought out that applications in hand and in sight for a share in the Wanaque water development now being carried out by the commission, will absorb the entire safe yield of that stream within a few years and that in addition other communities that are now turning toward the commission to invoke its services in providing for their future water needs will make it desirable, if not imperative, for the commission to develop a second source of supply. Present indications point to the Ramapo as this second source, especially since Bayonne, which had been granted a right of 50 m.g.d. in the Ramapo by the State Board of Conservation and Development, was recently enjoined from carrving out this plan because the courts held that approval of the North Jersey District Water Supply Commission as well as of the State Board of Conservation and Development was essential.

The hearing developed the fact that, acting upon the advice of Robert Spurr Weston, consulting sanitary expert, Boston, Mass., the city authorities of Bayonne would probably apply to the North Jersey District Water Supply Commission within a short time for 20 m.g.d. with the understanding that the Ramapo source would be developed as well as Wanaque. It appears that the safe yield from the two collecting areas would be at least 100 m.g.d. and 50 m.g.d., respectively.

WANAQUE DEVELOPMENT

After joint negotiations between Newark and some of the other municipalities to the north looking toward the filing of applications with the North Jersey District Water Supply Commission for the development of the Wanaque, some time back, had come to nothing, the city of Newark alone applied to the commission for this development up to 50 m.g.d. As a result, the Wanaque Dam has been under construction for some time past, with foundations sufficient for raising the dam to store the entire yield of the stream, and work has been started on a conduit therefrom to Newark. Recently the town of Montclair applied to the North Jersey Water Supply Commission for 3 m.g.d. from the Wanaque. Since then the serious shortage of water in the districts to the north and east of the Newark-Montclair-Paterson area seems to have stimulated other municipalities to apply for rights in the Wanaque. Applications actually filed up to Nov. 1, together with three about to be filed, follow: Newark, 25 m.g.d.; Paterson, 25; Passaic, 16; Kearney, 15; Bloomfield, 4; Montclair, 3; Glen Ridge, 1; total applications actually filed 89, to which may be added the proposed applications from Clifton of 6 and from Harrison of 9 m.g.d.

Bayonne notified the commission that it would like a month longer in which it might apply for 20 m.g.d.

The consensus of opinion at the meeting, both on the part of the municipalities represented and those of the North Jersey District Water Supply Commission, was that the commission should immediately make estimates on the cost of a joint Wanaque-Ramapo development along the general line recommended to Bayonne by Mr. Weston. Strong sentiment was also expressed in favor of giving careful consideration to the acquisition by the commission for the various municipalities in North Jersey of the properties of the East Jersey Water Co. and its associates, and also of the Hackensack Water Co. which supplies altogether some 50 municipalities.

The representative of Hoboken stated that his city had just made a contract with Jersey City for five years under which the latter would supply Hoboken, the price to be $77.50 p.m.g. against $138 p.m.g. for water from the Hackensack Water Co. which has supplied Hoboken for a number of years past. Bayonne is now supplied from the Little Falls filter plant of the East Jersey Water Co.

$108,000 Available to Study Engineering Education

The Carnegie Foundation has authorized the appropriation of $108,000 to be spent in a study of engineering education under the direction of the Society for the Promotion of Engineering Education. The resolution of the Foundation reads as follows: "Resolved, That the sum of $108,000 be, and it hereby is, set aside for the purpose of making possible a study of engineering education under the direction of the Society for the Promotion of Engineering Education; that of this sum the following amounts be, and they hereby are, made available to the society; $24,000 during the present fiscal year, $12,000 during the fiscal year 1924, with the understanding that if, in the judgment of the executive committee, substantial progress shall have been made in this study by Jan. 1, 1925, the balance of the $108,000 will be made available to the Society as follows: $24,000 additional during the fiscal year 1924, $48,000 during the fiscal year 1925."

Philadelphia Sewage-Works Put in Operation

Special Correspondence

The first unit of Philadelphia's extensive new sewage-works was put in operation on Oct. 29. The plant is known as the North East Sewage-Works, and is located on the Delaware River, between Erie Ave. and Lewis St. It consists of 32 Imhoff tanks and 80 sludge drying beds, and has a capacity of 60 m.g.d. The plant is designed to provide for 300,000 people, and is one of four similar units to be constructed at the North East works, which will have a total daily capacity of 250,000,000 gallons. The cost of the new plant was $1,830,000.

Besides the North East plant, the city will build two others, known as the South East and the South West sewage-works. The capacity of the three plants will be 800 m.g.d. The South West plant is under contract.

San Francisco Engineers Discuss Needed Contract Changes

Lower bids on construction work could be secured if owner and engineer would prepare contracts and specifications with more regard to the contractor's point of view; this was the keynote of discussion at a meeting of the San Francisco Section of the American Society of Civil Engineers on Oct. 16. The paper of the evening was "The Contractor and the Engineer," read by H. Nunn, general manager of the Contractor's Association of northern California and former state highway engineer of Oregon. Both engineers and contractors entered into the discussion but the contractor's point of view was presented and defended by both sides, indicating that changes in contract forms which would relieve the contractor of undesirable limitations would be generally welcomed.

Mr. Nunn's classification of all highway contractors in Oregon showed that half of them had engineers in charge of their work or were formerly engineers themselves. If the reverse of that could be true, it was pointed out, a better relationship between engineer and contractor would obtain. Points emphasized during the evening were as follows:

The contract forms themselves are most urgently in need of improvement and the administration of contract terms follows as a close second. The contractor must bid high enough to cover the cost of work plus a profit, a profit commensurate with the risk the specifications impose.

When a contractor makes a competitive bid he must base his figures on the minimum cost the specifications will permit. Specifications should therefore be definite as to what will be accepted.

Considerable discrepancies between the engineer's estimate and the contractor's bid may be due to hazards imposed by contract forms. The engineer makes his estimate without any uncertainty about administration of contract terms, while the contractor's bid must take into account all hazards expressed or implied by the contract.

East Jersey and Associated Water Companies Consolidate

A merger of the East Jersey, Passaic, Aquackanonk, Montclair and Kearney Water Companies under the name of the Passaic Consolidated Water Co. has been effected. The merger was approved on Oct. 30 by the Public Utility Commissioners of New Jersey. It is reported that the new companies will apply to the commission for authorization of $8,000,000 of 6 per cent mortgage bonds and $3,500,000 of capital stock, as against book assets on Dec. 31, 1922, exceeding $13,000,000.

The five companies jointly own water diversion rights, pumping and filtration plants at Little Falls, a large trunk main and a storage reservoir, together with the water distribution systems that supply Paterson, Passaic, Clifton and Montclair, and have contracts for supplying water in bulk to other communities. In March of this year the entire property was valued at $11,500,000 for rate-fixing purposes.

Iowa Water-Works Men Discuss Dozen Topics

Well Supplies for Small Water-works, Records, Inspection, and Publicity Draw Lively Interest

Engineering News-Record Staff Report

Water-works operators and others interested in water supply from eight Middle West states attended the ninth annual meeting of the Iowa Section of the American Water Works Association, Oct. 24, 25 and 26, at Ames, Iowa. While the papers ran the whole gamut from finance to laboratory control of quality, together with "fringe" subjects of electrolysis and city grading for insurance rates, the livest discussion revolved around well supplies and tastes and odors. The latter subject was on the program only as a "round table" discussion but it was good for a full hour and a half, winding up in a detailed account of troubles with filters in the fall due to surface sand clogging and methods to lengthen runs.

A paper on "Operation Records for Small Water-Works" by Earle L. Waterman, associate professor of sanitary engineering, State University of Iowa, led to the appointment of a committee to co-operate with similar cimmittees of the national association or of other sections. Prof. Waterman estimated that of 500 plants in Iowa 490 deliver less than 3 m.g.d. and 464 less than 0.5 m.g.d. In this last group the memory of the plant superintendent is too often the principal repository of records and what the old operator knows is not inherited by a newly appointed one. Reports are required at frequent intervals by the State Board of Health and the State Public Utilities Commission. If daily records are kept these periodical reports are not a burden.

Publicity Methods

J. J. Hinman, Jr., associate professor of sanitation and chief of the water laboratory division, State Board of Health, University of Iowa, in his paper on "Publicity at the Water Plant" described educational and publicity methods used in taking the public into the confidence of the water-works officials. If the people knew the truth about their own supply they would object less to what they call "chemical doping" for their own protection. An exhibit of the small amount of alum necessary to coagulate 1,000 gal. or of liquid chlorine in a tube to disinfect the same amount of water will usually disarm the most confirmed complainant.

The Ames college and town shallow well supplies described by P. F. Hopkins, city engineer, and C. S. Nichols, professor of sanitary engineering, Iowa State College, came in for much discussion, particularly condemnatory discussion of the college supply, which consists of wells in experimental hog lots on low ground between the town and college, with a sewer (having poor joints) on one of the sloping banks. While the original 100-ft. wells always showed an absence of pollution, an additional well, driven during the war was found full of gas-forming aerogenes and some B.coli by the college water analyst when he returned from service. No analyses were made during the war. No attention was paid to his warnings nor to his insistence that the well casing must be leaking. In fact, the validity of his tests were attacked although all of the old wells continued to show the usual excellent results. Finally the casing had to be drawn because it became clogged with sand. Nearly every joint was found defective. Daily analyses are now routine and the sanitary engineering department hopes some time that the aesthetic's objections to hogs around the well houses may be removed though it is conceded that it will probably be easier to "pull up the wells and sell them for post holes" than, under the political control of grounds supervision existing, to re-allocate the hog pens and pastures.

Dr. Max Levine, associate professor of bacteriology, Iowa State College, and Clair S. Linton, research assistant, have been working for several years on 123 bacterial strains of soil and intestinal origin to differentiate B.coli from B. aerogenes. Satisfactory methods based largely on reduction of various carbohydrates have been developed, rather than the former methods of the inhibition of attenuated strains by bile and phenolated broth.

The well discussions followed papers by Dr. Edward Bartow, head of the department of chemistry, State University of Iowa, H. V. Pedersen, state sanitary engineer, and Dr. S. W. Beyer, dean of industrial science and head of geology, Iowa State College. Dr. Bartow described an unusual seasonal variation of iron in the well water supply of Benham, Ky., from 1.5 p.p.m. in December to 65 p.p.m. in February. Mr. Pedersen emphasized location and proper precautions against surface and pump-pit contamination. Dr. Beyer sounded a warning against the dangers of ground-water depletion by extravagant waste.

George W. Fuller, president of the national body, spoke on his recent inspections of European water and sewage plants. Double filtration seems to be on the increase both in England and on the Continent.

The newly elected officers of the section are as follows: Chairman, H. F. Blomquist; vice-chairman, Dr. Max Levine; directors, L. O. Minor and Thomas Healey. By constitutional requirement the next meeting will be held at Iowa City.

A. G. C. and Road Builders To Meet Jointly

A joint meeting of the Associated General Contractors and the American Road Builders' Association will be held in Chicago on Thursday, Jan. 17, 1924, to discuss various matters of importance to the membership of both organizations. This joint meeting has been made possible by the proximity in dates of the annual meetings of these organizations in Chicago. The 1924 conventon of the Amercan Road Builders' Association will be held Jan. 15 to Jan. 18 inclusive. while the Associated General Contractors meet the following Monday, Tuesday and Wednesday. All the officers, the executive committee and the heads of the twenty-eight chapters of the Associated General Contractors will, however, be in Chicago the previous week. Many of the members of the organization also will be in Chicago that week attending the convention and road show of the American Road Builders' Association. Plans accordingly have been made for the joint meeting. Details of the program will be announced shortly.

Random Lines

Making Railroad Service Attractive to the Engineer

Extract from Letter to a Recent Technical Graduate

Sir—In reply to your application I wish to advise that at present there is a vacancy for a rail inspector on the Blank Division of the Blank R.R., which pays a salary of approximately $83 per month.

The duties are to make daily inspections of the track structure for defects and failures, together with frequent assignments to field and office work of the engineering corps. This position should be of interest to a young technical graduate who is desirous of starting in a railroad engineering career as the general experience gives a practical first-hand knowledge of track and other structures and should be of lasting benefit as he progresses, through promotion, to the various grades in the engineering department, which are rated as follows:

Chainman	$110 per month
Rodman	120 " "
Inspector & Draftsman	140 " "
Transitman	165 " "

(Signed) ———
Division Engineer.

Extract from Report of Interstate Commerce Commission Wage Statistics, Steam Roads in the United States.

Title	Average Monthly Earnings Per Employe
Maint. of Way General Foremen	$244
Maint. of Way Inspectors	173
Masons, bricklayers, etc.	152
Gang foremen	162
Laborers	78

* * *

More Definitions

Display Engineers—San Francisco window trimmers.

Correspondence Engineers—Baltimore, Md., "The Better Letters Co."

Automotive Painting Engineer—"No talent or education necessary," apparently an ideal vocation for morons. Advertised in *Popular Mechanics.*

Box Engineers—Our old friend the "packing engineer" under another name. Advertised this time in *The Nation's Business.*

* * *

The American Society of Exterminating Engineers has a member in Bristol, Pa., who is an undertaker by vocation. That's service for you. Kill 'em and bury 'em for the same fee and with the same organization.

* * *

"Stops Water Pollution By Bathing in Canals" says a headline in the September *Reclamation Record* (now being run by business men). What's the use of spending money on purification plants or chlorine; just hire a crowd of boys.

Engineering Societies

Calendar

Annual Meetings

AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS, St. Petersburg, Fla.; Annual Convention, Atlanta, Ga., Nov. 12-16.

CITY MANAGERS ASSOCIATION, Lawrence, Kansas; Annual Meeting, Washington, D. C., Nov. 13-15.

FEDERATED AMERICAN ENGINEERING SOCIETIES, Washington, D. C.; Annual Meeting, Washington, D. C., Jan. 10-11, 1924.

AMERICAN ROADBUILDERS' ASSOCIATION, New York City; Annual Convention, Chicago, Jan. 14-18, 1924.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York City; Annual Meeting, New York, Jan. 16-18, 1924.

ASSOCIATED GENERAL CONTRACTORS OF AMERICA, Washington, D. C.; Annual Meeting, Chicago, Ill., Jan. 21-23, 1924.

AMERICAN CONCRETE INSTITUTE, Detroit, Mich. Annual Meeting (20th anniversary), Chicago, Ill., Feb. 25-28, 1924.

Western Society of Engineers at a luncheon on Oct. 26 was addressed by A. A. Sprague, commissioner of public works, Chicago, on the subject of "What the Engineers Can do for the City."

The South Carolina Chapter of the American Association of Engineers held its annual meeting at Columbia, S. C., Oct. 26, with an attendance of 64. Officers for the coming year were elected as follows: President re-elected, L. M. Fisher, associate sanitary engineer of the United States Public Health Service, Columbia, S. C.; vice-presidents, L. S. LeTellier, head of the department of engineering, the Citadel, Charleston, S. C., and Harwood Beebe, municipal engineer, Spartanburg, S. C.; and secretary-treasurer, Perry M. Teeple, associate professor, school of engineering, University of South Carolina.

Personal Notes

EDWARD M. CRAIG, JR., Wanaque, N. J., is now sanitary engineer for the North Jersey District Water Supply Commission, engaged in providing water supply for metropolitan New Jersey, under direction of Weston & Sampson, consulting sanitary engineers, Boston, Mass. Mr. Craig until recently was assistant sanitary engineer with the Alabama State Board of Health.

THOMAS A. MARTIN, Los Angeles, Calif., is connected with the Lynch Cannon Engineering Co., as engineer in charge of erection of Union Pacific railroad shops. He previously was in charge of construction work for Whitehead & Kales Iron Works of Detroit, Mich.

A. P. SMITH, Charlotte, N. C., formerly engineer for the Nashville Bridge Co., Nashville, Tenn., is now engineer for the Southern Engineering Co., Charlotte, N. C., whose business is structural steel construction.

EDWARD B. DARLINGTON has been appointed project manager of the Minidoka project of the U. S. Reclamation Service in Idaho, with headquarters at Burley, Idaho. He will have local charge of the irrigation works in that vicinity, including the Minidoka dam, power plant, pumping station and canal system. Mr. Darlington for several years has had charge of operation and maintenance of the Twin Falls-Salmon River irrigation project, and later was chief engineer of Twin Falls North Side Land & Water Co., at Jerome, Idaho. During the past year he has investigated several irrigation projects for the State Bond Commission of Idaho.

DAVID ANDERSON, chief engineer of the Armored Concrete Construction Co. of Malmo, Sweden, recently came to this country for a two months' tour of eastern United States, Canada and the Middle West, to be devoted to the study of engineering and construction work in general and reinforced concrete in particular. Besides the firm he represents, he travels also in behalf of the Manufacturing and Industrial Society of the City of Malmo.

RANDALL E. EVANS, Queens, Long Island, N. Y., has changed from structural engineer with McClellan & Junkersfeld to the same position with Stevens & Wood, engineers, New York City.

J. B. JONES, Houston, Texas, is now doing field engineering work in the valuation department of the Southern Pacific R.R. He was formerly a draftsman in the maintenance-of-way department.

C. CLIFFORD CLARK is now associated with the Roxana Petroleum Corp., Arkansas City, Kansas, as drainage and sanitary engineer. He was previously a draftsman with the Marland Refining Co., at Ponca City, Okla.

W. E. BARLOW, formerly assistant superintendent of the H. P. Burgard Co., is now superintendent on concrete construction work for Rock Bros. & Griffin, at Lowville, N. Y.

NORMAN EAGER, Carbondale, Ill., has been made a junior highway engineer. He previously served as draftsman on highway work in Pennsylvania.

HERBERT HOEFER has changed his association from engineer with Temple & Burrows, Davenport, Iowa, to engineer with the Building Products Co., Toledo, Ohio.

GEORGE D. HALL, Auburn, Ala., has become superintendent of construction for the Opelika Lumber and Construction Co., Opelika, Ala., after having done similar work for the West Point Iron Works, West Point, Ga.

WALTER E. GILLHAM announces that BENJAMIN F. COOK and W. EMERY WHITE, who have been associated with him for a number of years, are now members of the firm, which is now known as Gillham, Cook & White, consulting engineers, and which is now located at 409 Interstate Bldg., Kansas City, Mo.

T. J. STRICKLER, formerly chief engineer of the Empire Gas & Fuel Co. of Bartlesville, Okla., is now associated with F. C. Hamilton, consulting engineer, 60 Wall St., New York City.

STUART B. OVER, formerly senior assistant engineer in the Valuation Division of the Interstate Commerce Commission, and FRANCIS TINGLEY, formerly supervisor of overhead lines for the Washington Railway & Electric Co., Washington, D. C., have formed a partnership under the name of Over & Tingley to do general engineering, the address being Upper Darby, Pa.

PHILIP P. SHARPLES, formerly manager of the General Tarvia Department of The Barrett Co., has entered private practice in highway engineering. He has been retained as consulting engineer by the Palos Verde Co. to design and construct roads and pavements in their development at Redondo Beach, Calif.

Obituary

MORTIMER S. SMITH, assistant division engineer of the New York State Highway Commission and for 28 years associated with the state engineer's office in New York, died Oct. 29 at his home in Rochester, N. Y., after a short illness; he was 51 years of age. Mr. Smith was born in Rochester and educated in private schools. He spent four years in Scranton, Pa., as resident engineer for the Delaware, Lackawanna & Western R.R., otherwise his work was all in Rochester.

EDWARD E. SANDS, consulting engineer of Fort Worth, Texas, and for five years city engineer of Houston, Texas, died at the home of his father in Milwaukee, Wis., Oct. 27, aged 46 years. A native of Columbus, Ohio, Mr. Sands was graduated from the University of Wisconsin with a B. S. degree in civil engineering in 1900, receiving his C. E. from the same institution in 1906. During the two years following his graduation he was an instructor in civil engineering at the university, spending his summers as city engineer of Sparta, Wis. In September, 1902, he entered the U. S. Reclamation Service. He became designer and builder of the South Canal of the Uncompahgre Valley project in Colorado, later was in charge of the Uncompahgre project, and was project engineer on the Grand Valley project. Leaving the Reclamation Service for a few months in 1910, he became associated with J. G. White & Co. as construction superintendent in Washington State. Mr. Sands returned to the Reclamation Service in 1911 for a year, then went to Canada as supervising engineer on Canadian Pacific irrigation development. From there he went to Houston, Texas, as city engineer, resigning in 1918 after five years' service to enter private practice. While in Houston he designed and built the city's activated sludge plants, the largest of their kind, and designed most of the terminal facilities for the Houston ship channel. Since Oct. 1, 1922, he had been a member of the consulting firm of Hawley & Sands, designing and supervising water and sewerage plants for many Texas cities, among which was the Fort Worth $1,250,000 sewage disposal plant. Mr. Sands was a member of the American Society of Civil Engineers and past-president of the Texas section of the society.

From the Manufacturer's Point of View

A Point of Contact Between Maker and User of Construction Equipment and Materials

Manufacturers Oppose Ban on Trade Statistics

Important Issues Involved in Tile Maker's Case Now Before Dept. of Justice

In the draft of a proposed consent decree in the case of United States vs. Tile Manufacturers' Credit Association et al., it is proposed by the Department of Justice to enjoin the defendants in the mentioned case from collecting certain types of statistical and other information. It would be provided, however, that such association might receive and compile, for transmission to any government agency, such information and statistics as such government agency might request as to production, stocks on hand and prices. However, such association would be restrained from distributing information so collected among its members. The permissive features of the proposed decree follow the general lines of the consent decree entered in the case of the Gypsum Industries Association, which made no mention of the subject of statistics.

Through its counsel, Nathan B. Williams, the National Association of Manufacturers has urged that in the public interest the draft of the decree be modified by the elimination of all reference to government departments. The collection of information by government departments, it is pointed out, is properly controlled by statute. The association has further urged that in the description of permissible activities of trade associations cost-accounting be included and that such decree carry the following paragraph relating to the subject of statistics:

RECORD OF FACTS WANTED

"To periodically or otherwise collect and make currently and otherwise available to those interested the facts relating to capital employed, power used, wages and [or] taxes paid, fuel consumed, machinery employed, and like pertinent trade information, production, sales, shipments, and stocks on hand of tiles and the prices obtained therefor, all of such being a record of accomplished facts."

In further recognition of the public interest to be protected the manufacturers' association has suggested that in addition to the availability of such statistics to those interested a prohibition might properly be contained in such decree against the misuse of otherwise legitimate activities and information in furtherance of any agreement or conspiracy to fix prices, limit production, restrict sales, divide territory, or in any manner restrain lawful competition in commerce.

The manufacturers' association has pointed out the vital necessity of business information and the serious consequences to the business fabric if the proposed decree should be entered in its present form. Such a decree would, Mr. Williams states, serve notice upon all trade associations that the Department of Justice regards the collection of statistical and other trade information, because occasionally misused, within the condemnation of existing law, and to be prohibited in so far as the Department of Justice was able to accomplish that end.

Slate Producers Investigate Nailing Problem

The National Slate Association, as part of its program to assure the public satisfaction in uses of slate, is conducting an investigation to determine the proper kind of nails to use for applying slate roofts. Architects, engineers, roofers and manufacturers of nails of all kinds are co-operating in this work. Results of this survey will be made known at slate industry meetings in New York in January.

Sixteen Companies Fined $20,000 for Sherman Law Violations

Fines aggregating more than $20,000 were imposed Oct. 30 for alleged violation of the Sherman anti-trust law upon sixteen heating and plumbing defendant companies of the Middle West by the Federal Court in Chicago, in the case of the United States vs. James B. Clow & Sons, et al, Attorney General Daugherty was advised by Roger Shale, special assistant to the attorney general, who, under direction of Mr. Daugherty, has been in charge of the case. The sixteen companies entered pleas of guilty.

The government at the same time the court imposed the fines dismissed the first of the two counts of the indictment returned against the defendants. The companies involved and the fines imposed follow:

James B. Clow & Sons	$4,000
Standard Sanitary Manufacturing Co.	4,000
Kellogg Mackey Co.	3,000
L. Wolff Manufacturing Co.	3,000
Weil-McLain Co.	2,000
Western Plumbing Supply Co.	500
Davies Supply Company	500
National Plumbing & Heating Supply Co	500
Whitney & Ford	500
Illinois Malleable Iron Co.	500
Enterprise Plumbing Supply Co.	500
Walworth Manufacturing Co.	500
Hoelscher Bros.	200
S. Deschauer Co.	100
Quinn Supply Co.	100
Weir & Craig Co.	100
	$20,000

The second count of the indictment against the firms charged the defendants with having conspired to fix and maintain uniform and non-competitive prices for plumbing and heating apparatus and fixtures sold to retail dealers and master plumbers in several states in the Middle West. The scheme forming the basis of the second count was said to have been carried out largely through the instrumentality of a publication known as the "Clow Bulletin." This bulletin, the Department of Justice said, embraced several of the objectionable practices engaged in by so-called open-price associations. The bulletin was distributed and used by approximately 4,500 master plumbers, 415 jobbers and 100 steamfitters.

Hydraulic Turbine Business Taken Over by Newport News Company

An arrangement has been effected between the Wellman-Seaver-Morgan Co., Cleveland and Akron, Ohio, and the Newport News Shipbuilding & Dry Dock Co., Newport News, Va., whereby the latter company has taken over the future hydraulic turbine business of the Wellman-Seaver-Morgan Co., including the patterns, drawings, data, patents, patent applications, developed and undeveloped inventions and complete records, the results of their years of experience in the hydraulic turbine business. The sales offices of the Wellman-Seaver-Morgan Co., in New York, San Francisco and Birmingham will continue to function as heretofore and will represent the Newport News company in hydraulic turbine work. The Wellman-Seaver-Morgan Co. will complete its present hydraulic turbine contracts without reference to the Newport News company. Future contracts will be taken by the Newport News company.

This change in policy according to a joint statement of the presidents of the two organizations, Edwin S. Church and Homer L. Ferguson, will enable the Wellman-Seaver-Morgan Co. to handle all its other lines of work to better advantage and will enlarge the work of the Newport News Shipbuilding & Dry Dock Co.

Cut Made in Varieties of Hollow Building Tile

Manufacturers of hollow building tile together with representatives of distributors and consumers of this commodity met Oct. 19 in the Division of Simplified Practice of the Department of Commerce, Washington, D. C., and unanimously adopted as the future standard line 11 sizes of load-bearing wall tile, 6 sizes of partition tile, 1 size of furring tile, and 1 size of book tile. This action reduces former sizes from between 40 and 50 to 19.

A standard weight for each standard size was also adopted. This in itself is a further simplification, as heretofore there has been a great variety in weights of tile of the same size. Agreement was also reached that the permissible tolerance or allowable variation in weight shall not exceed 5 per cent over or under the standard; also that maximum variation in the major dimensions—length, width, and height—shall not exceed 3 per cent plus or minus.

The general adoption of these standards by architects, engineers, and builders will facilitate their work and tend to lower construction costs. The action of the conference marks another step forward in Secretary Hoover's program for eliminating waste in industry through reducing variety in commonly used commodities.

Cast-Iron Pipe Production

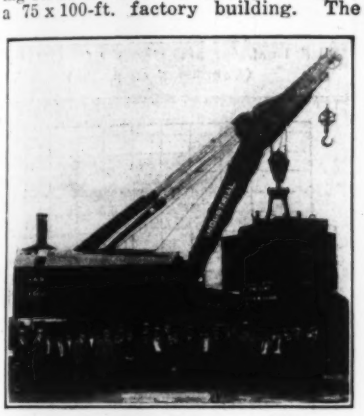
Based on returns from twelve establishments in the United States and confined to bell and spigot pressure pipe, statistics on the production, orders, sales, and shipments of cast-iron pipe for the month of August, 1923, have been issued by the U. S. Department of Commerce. Production during the month totaled 84,588 tons, while shipments amounted to 84,843 tons.

Industrial Works Celebrate Fifty Years of Crane Manufacture

In commemoration of its fiftieth anniversary the Industrial Works, Bay City, Mich., manufacturers of locomotive cranes, buckets and pile-drivers, held a celebration, sales conference and banquet last month. Addresses were made by William L. Clements, president, C. R. Wells, secretary and treasurer and Ernest B. Perry, general manager. The attendance of members of the organization and guests was about 300.

W. L. CLEMENTS

The records of the beginning of the Industrial Works in 1873 show a working force of about 30 men operating in a 75 x 100-ft. factory building. The plant of today covers twenty-nine acres, comprises fifty-nine buildings with 440,000 sq.ft. of covered floor area, served by five miles of railroad track, and in normal times gives employment to about eighteen hundred men.



200-TON CRANE TESTED AT COMPANY'S 50TH ANNIVERSARY

At the sales conference were present company representatives from all principal points of the United States, Canada, Cuba, and South America. During the conference the representatives witnessed the testing of a 200-ton Industrial crane for the Norfolk & Western R.R., one of the largest cranes in the world.

Too Little Time Allowed for Preparing Bids

Equipment Manufacturers Receive Scant Opportunity for Study of Problems on Proposed Work

BY CHARLES G. RICHARDSON
Builders Iron Foundry, Providence, R. I.

In the following discussion Mr. Richardson calls attention to a practice which is objectionable from many angles. How can the maker and user of equipment co-operate to prevent it? Comment is invited from other manufacturers and from engineers or state and city officials suggesting remedies.—EDITOR.

WE manufacturers of municipal equipment have a grievance: it is the shortness of the time interval usually allowed between the contract advertisement and the date of receiving bids. Engineers often and properly take many months in the preparation of their plans and specifications and the majority of these are admirable examples of draftsmanship and clearness. But once this work is done the time for the preparation of the contractor's proposal apparently receives scant consideration.

I am referring particularly to contracts for waterworks, sewage disposal and filtration. Perhaps two weeks is the average interval between the advertisement and the final date for bidding. Within this time the manufacturer must send a deposit for the plans and specifications, requiring frequently nearly a week for their receipt, and there is left only two or three days to study the various problems involved, perhaps design special equipment, prepare drawings and specifications, and get them all, together with formal prices and deliveries, into the hands of the inquiring bidders in time for the latter to make use of them.

Meanwhile the bidders themselves are in an even worse turmoil in figuring the complete contract and the total result is all too often a proposal far less complete and acceptable to every one concerned than would have been possible under a longer time allowance. Four weeks is none too long to give manufacturers and bidders on such contracts a chance to prepare a carefully considered offering, one not only satisfying to the conscientious manufacturer of equipment but also most suitable for the job.

Isn't there some way, by a little more forethought, of avoiding this rush, typically American, in work which is highly deserving of careful and detailed attention?

Weekly Tips for Manufacturers in Construction News

Heretofore reports on machinery and building materials have been published in the Unclassified columns of Construction News. Beginning next week such reports will be found in Construction News under the heading Materials and Equipment. This week's items are as follows, all verified:

PROPOSED WORK

Rock Asphalt — New Orleans, La.—W. Ball, purch. agt., City Hall, soon takes bids 300 tons Uvalde rock asphalt. A. Black, comr. Dept. Pub. Property.

Rock Crushing—Manitowoc, Wis.—Plans to purchase rock crushing outfit during 1924. $6,000. A. H. Zander, city clk.

Steam Roller or Street Scarifier—Faribault, Minn. — Plans to purchase steam roller or street scarifier. E. Johnson, city clk.

BIDS DESIRED

Cement, Etc.—New York, N. Y.—Nov. 13, by J. Miller, pres. Manhattan Boro, Municipal Bldg., 5,000 bags Portland cement and 2,000 cu.yd. asphaltic wearing surface sand.

Dragline Bucket — Covin, Ala. — D. W. Robins in market for one dragline bucket.

Gravel—Baton Rouge, La. — Nov. 13, by State Hy. Dept., Reymond Bldg., furnishing 30,849 cu.yd. 60% sand clay gravel or as alternate 10,286 cu.yd. washed gravel and 20,563 cu.yd. 40% sand clay gravel, for surfacing Federal Aid Project 81, Sects. A and B, St. Francisville-Mississippi Highway, West Feliciana Parish. J. M. Fourmy, ch. engr.

Paving Brick—Youngstown, O.—Nov. 15, by Director Pub. Wks., 250,000 paving brick. $8,000.

Crushing Plant—Owatonna, Minn.—Nov. 13, by Steele Co., 1 portable combined gravel, screen and crushing plant, 8 x 36 in. crusher. R. W. Hosfield, Owatonna, engr.

Scraper—Plano, Tex.—J. L. Aldridge taking bids Fresno scraper.

Sluice Gates—Exchequer, Calif.—Nov. 20, by Directors Merced Irrigation Dist., Merced, 2 sluice gates, 277 static head operated under 100 ft. 28-30 ft. to discharge, 6 ft. diam. sluiceway, for Exchequer Dam, here. Starr-Thebo-Anderton, Sharon Bldg., San Francisco, engrs.

Railroad Ties—North Bay, Ont.—Temiskaming & Northern Ontario RR., North Bay, in market for 350,000 railroad ties, $300,000. S. B. Clement, ch. engr.

BIDS RECEIVED

Road Surfacing Material — New York, N. Y.—See "Streets and Roads."

CONTRACTS AWARDED

Street Sweeper—Hanford, Calif.—Motor driven street sweeper to S. S. Smith, 62 Market St., San Francisco, $7,200. Noted Oct. 20.

Business Notes

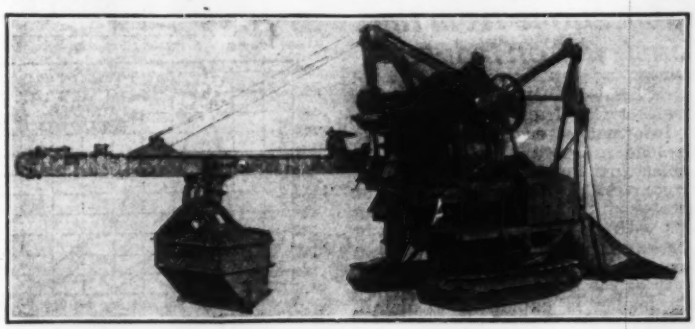
BARRETT CO. announces the resignation of Philip P. Sharples, technical adviser, after a period of 20 years of service with the organization. Further details will be found in the "Personal Notes" column of this issue.

MORRISON & RISMAN CO., Buffalo, N. Y., dealers in railway track equipment, announce the establishment of a district sales office in the Ulmer Building, Cleveland, in charge of R. B. Morrison. Warehouses are being equipped at Cleveland, in addition to those already in service in Philadelphia, Buffalo and Lebanon, Pa.

Equipment and Materials

Paving Mixer for City Work Designed for Low Headroom

For city paving work where a large capacity paver is desired, the Koehring Co., Milwaukee, has developed a special design of headframe on its 21E paver.

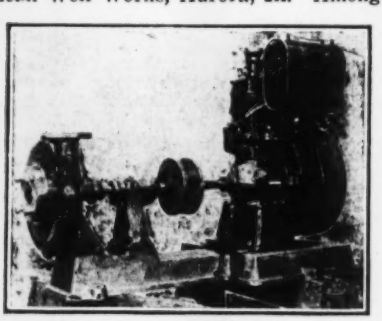


The uprights supporting the sheaves through which the charging skip cables run are bolted and hinged in such a way that after the bolts are removed the upper framework may be tipped back by the skip hoist clutch, thus reducing the height of the machine, and allowing it to pass beneath low telegraph wires and other obstructions.

The minimum height from ground of the paver with this special frame is 10 ft. 9¼in. with truck wheels, 10 ft. 11¼ in. with half-length multiplane, and 11 ft. 2¼ in. with full-length multiplane. This arrangement also permits the loading of machine on a flat car for shipment without any dismantling further than the boom and skip.

General Purpose Pumping Unit

A contractor's general purpose pumping unit, consisting of a standard 2½ in. American centrifugal pump direct-connected to a New Way gasoline engine, the whole outfit being mounted on a cast-iron base, has recently been placed upon the market by the American Well Works, Aurora, Ill. Among



the advantages claimed for it by the manufacturer is the connection of the pump to the engine through a flexible coupling, the shaft being supported on a pedestal bearing. This feature is designed to insure long life for the equipment. In addition, a thrust bearing is provided to meet the most rigorous conditions of general service.

The cast-iron casing of the volute type may be swung on its bolts so that the discharge opening may have any of eight positions. The suction nozzle is cast in the casing and companion flanges are furnished for suction and discharge openings. The impeller is of cast iron, machined and balanced.

The unit is made in only one size and is designed for heads up to 75 ft., with a delivery, under field conditions, of from 50 to 250 gal. per minute. Under a 50-ft. head the pump, operating at 1,000 r.p.m., delivers 120 gal. per minute. The manufacturer emphasizes the compactness of the unit which occupies a floor space of 3 x 1¼ ft.

Publications from the Construction Industry

Truck Loaders—GEORGE HAISS MANUFACTURING CO., INC., New York, presents information on its path-digging truck loaders in a 28-p. illustrated pamphlet just published. The equipment consists of an endless chain of buckets mounted on a crawler-driven chassis with special material-gathering and discharge features. Operating data are presented to indicate the working capacity of the machine and the design of the loader is explained in detail.

Business Side of Construction

FACTS AND EVENTS THAT AFFECT COST AND VOLUME

The Industrial Situation as Shown by Industrial Expansion

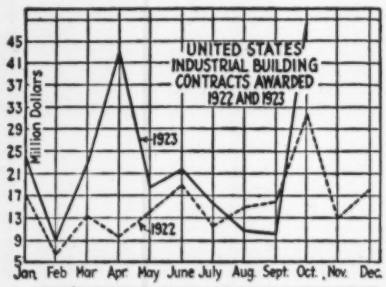
Whether business is good, bad or indifferent can best be judged by the rate at which industrial building is going on. When plants and factories are multiplying and expanding it is reasonable to suppose that the owners look with confidence to the future. Heavy industrial building not only gives employment to construction men, but also means many orders for machinery and equipment. If, on the other hand, industrial expansion is below normal the reverse is of course true.

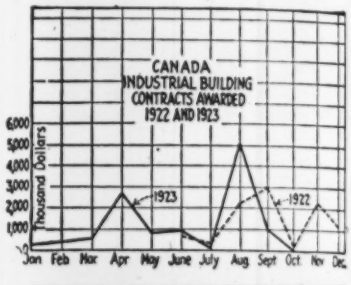
Contracts awarded on industrial projects in the first nine months of 1923 amounted to $187,648,000, against $133,178,000 in the same period of 1922, according to *Engineering News-Record* which published awards of $40,000 and over. This is an increase of $54,470,000 and will probably place this year's total above that of last year. But it is noteworthy that most of this increase occurred in April, when $43,000,000 worth of work was placed under contract. May, June and July awards were heavier than those of 1922 and followed the same trend, as shown by Chart 1. Since August, however, the contracts have been notably lighter than in the same period last year.

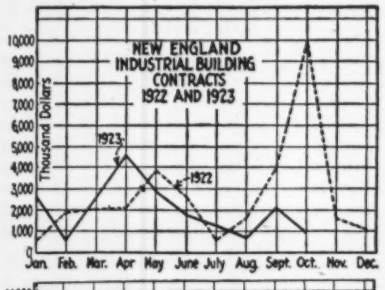
This falling off in industrial construction is quite general throughout the United States and Canada, the exceptions being the South and the region west of the Mississippi. The following table shows the situation in each section:

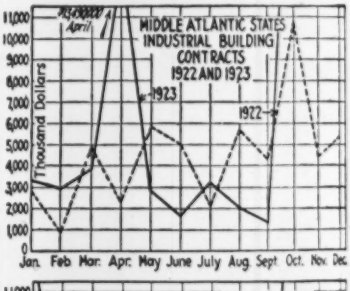
	1922		1923	
	No.	Value	No.	Value
N. E.	158	$20,765,000	175	$20,680,000
Mid. Atl.	282	37,991,000	236	36,813,000
South	53	18,325,000	82	10,605,000
Mid. W.	334	40,792,000	437	62,128,000
W. of Miss.	70	7,703,000	170	40,982,000
Far W.	60	7,602,000	126	16,440,000
U. S. Total.	957	$133,178,000	1,126	$187,648,000

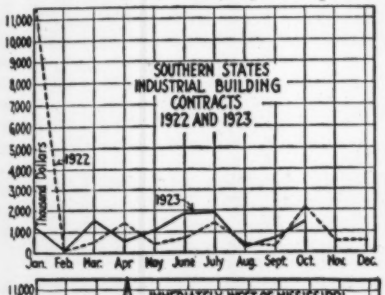
(*Concluded on p. 785*)

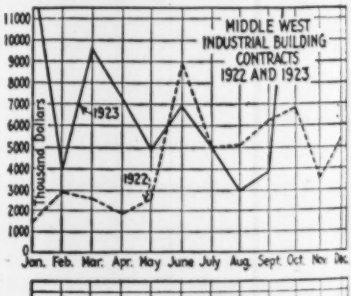


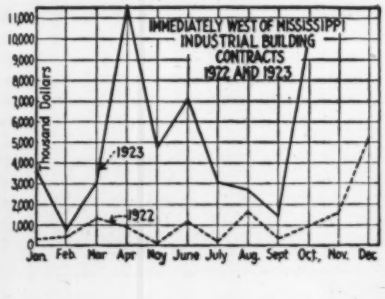


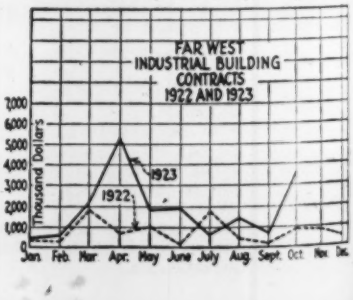












Production and Materials Stocks in Eleven Cities

Plenty of Brick, Cement, Lumber and Other Materials—Slight Drop in Steel Output

Steel—Production of steel ingots during October averaged between 3,000,000 and 3,200,000 tons, against 3,159,283 for the month preceding. This slight drop is seasonal and indicates satisfactory production conditions. Mills are operating at about 80 per cent of capacity. Demand, though low, is much better than was expected several months ago. No indications, however, point to a heavy production schedule for the coming Winter.

Lumber—The total output is now about 2½ per cent above normal, against 6 per cent above, one month ago and 2 per cent below normal one year ago. Production, shipments and orders, however, for the four weeks ending Oct. 20, show substantial gains over the preceding four weeks and also over the corresponding period in 1922. While shipments of Western fir to the Eastern states have declined somewhat owing to Japanese demand, Southern pine, which furnished 36 per cent of all lumber cut in the United States in 1922, has been able to meet the demand and to prevent any danger of lumber shortage. The lumber movement, according to the National Lumber Manufacturers' Association, is shown in the following table:

	Four Weeks Ending Oct. 20, Ft. b.m.	Four Weeks Ending Sept. 22, Ft. b.m.
Cut	1,113,268,502	1,076,178,223
Shipments	1,006,228,403	939,801,763
Orders	1,022,862,571	977,305,153

Cement—Production during the first nine months of this year totaled 101,016,000 bbl., against 81,563,000 for the corresponding period in 1922, according to the Geological Survey. With a gain of 23 per cent in production and only 18 per cent in shipments, a total of 5,492,000 bbl. were available, as a reserve stock for the nation, on Oct. 1, as against 4,724,000 on hand one year ago.

Brick—The report of the Common Brick Manufacturers' Association of America as of Oct. 1, shows 307,633,000 burned brick on hand at yards throughout the country, compared with 250,176,000 for the preceding month. Orders on books have increased during the last thirty days and production is preceding at an unprecedented rate in the face of the fact that 18,953,000 brick have been imported from Canada, Holland and Germany during the three months ending Sept. 30.

San Francisco—Stocks of building materials are large and easily obtainable, with the exception of blue annealed and black steel sheets and rivets.

Los Angeles—Demand steady and supply sufficient in all materials.

Denver — October lumber reserves largest of any month this year. Brick stocks 80 per cent heavier, compared with month ago.

Minneapolis—Ample stocks of all building materials, with some lightening of demand for brick and tile.

Detroit — Lumber dealers' stocks somewhat decreased. Several days required on large deliveries of hollow tile. Only a moderate supply of brick in local yards. Scarcity of Bermudez asphalt.

Chicago—Sewer pipe supply low; deliveries on some sizes take from three to four weeks.

Cincinnati—Plenty of all materials. Cement deliveries fair, compared with scarcity of a month ago.

New Orleans—All building materials in light demand. Stocks of all character are sufficiently abundant, with the possible exception of 4-in. sewer pipe.

Atlanta—Slightly more cement, steel, asphalt and lime on hand, than a month ago.

New York—Brick stocks 50 per cent heavier than winter reserves in any recent year. By the time Hudson River navigation opens up next season, plants along the river will have 600,000,000 brick ready for the spring market.

The Industrial Situation as Shown by Industrial Expansion

(Concluded from p 784)

Average value in 1923 was $153,000, compared with $139,000 in 1922.

The actual trends and current conditions in the various sections are given by the charts. Last year October was the banner month, following a slow, fairly steady improvement. This year's peak also occurred in October ($48,985,000) but there was a high point of $43,031,000 in April. Since June the curve declined until October, when the $20,000,000 Kearny, N. J., power project of the Public Service Corporation, swelled the total.

In the last four years the total and the average monthly value of industrial contracts in the United States in this nine-months period were as follows:

1920	$408,779,000	$45,419,000
1921	83,160,000	9,240,000
1922	133,178,000	14,797,000
1923	187,648,000	20,849,00

Bids Wanted on Big Jobs

Among the projects on which bids are either asked or will soon be called for in Construction News, pp. 253 to 263, are the following:

Station and Office, Louisville, Ky., Louisville R.R. Co., $1,250,000.

Tunnel, Oregon, Southern Pacific R.R. Co.

Bank and Office, Dayton, O., $1,500,000.

Bridge, St. Paul, Minn., Ramsey Co., $1,500,000.

Large Contracts Let During Week

Among the week's announcements of contracts awarded in Construction News, pp. 253 to 263, are the following:

Hotel, New York; N. Y., M. Gerschlesser, $1,250,000.

Hotel, Hot Springs, Ark., to Ault & Burden, Little Rock, $2,100,000.

Bank and Office, Richmond, Va., to J. T. Wilson, $1,000,000.

Apartment, Hollywood, Calif., to Hennessy Bros., Los Angeles, $1,000,000.

CONDITIONS OF MATERIALS STOCKS IN IMPORTANT CENTERS

Stocks on hand in approximate figures, example: (Common brick, Denver, 9,000,000); time required for delivery of carload lots to city job, example: (Sewer-pipe, Atlanta, 4 to 5 days); and stocks on hand in general terms, example: (Hollow tile, Cincinnati, plenty.)

	San Francisco	Los Angeles	Denver	Minneapolis	Detroit	Chicago	Cincinnati	New Orleans	Atlanta	Philadelphia	New York
Sewer Pipe	Large and easily obtainable	No shortage	Supply low	Ample	Plenty in sizes up to 36 in.	Supply low; del. on some sizes take 3 to 4 weeks	Stocks large	Scarcity of 4-in. gauge	Del. take 4 to 5 days	Enough to supply demand	Mill shortage on 15 to 36-in., double strength
Cement	Fairly well supplied	Sufficient; foreign shipments arriving	Enough	Plenty; del. prompt	Ample for present requirements	Very good supply	Del. fair	Plenty	About 65 cars	Shipped from mills as needed	Plenty; dealers' stocks small but mill del. prompt
Lime	Well stocked	Plenty	Sufficient	Enough	Supply good; del. good	Plenty	Enough	No shortage	About 75 cars	Sufficient	Market well supplied
Common brick	Large reserves	Demand being met	9,000,000	Demand lighter; plenty	Moderate supply in local yards	Sufficient	Ample	Sufficient	Plenty	No reserve stocks	600,000,000 to be ready for Spring del.
Hollow tile	Good and easily obtainable.	Supply equal to demand	Stocks low	Large reserves; demand falling	Several days required on large deliveries	Del. take one week	Plenty	Enough	Del. take 4 to 5 days	No reserve supply	No scarcity
Lumber	Very large reserve	Demand not greater than supply	15,000,000 ft.; largest this year	Supply larger owing to slackening of demand	Dealers' stocks decreased	Del. take 30 to 60 days	Sufficient	Stocks ample; pine in light demand	Plenty pine	Stocks in good shape	Del. take 5 weeks from mill
Asphalt	Unlimited native supply	Native reserves large	Sufficient	Ample	Del. good on Mex.; scarcity of Bermudes	Plenty	Ample	No market	About 70 to 80 cars	Sufficient to meet increased demand	Heavy reserves in N. J.
Structural steel	Plenty structurals; low on sheets and rivets	Sufficient	Warehouses well stocked	Enough in ware houses	No shortage of local warehouse stocks	Users' stocks low on bars and plates	Warehouse stocks large because of slower demand	Normal	About 4 cars	Supply ample for small tonnages	Demand for structurals active; warehouse stocks sufficien

Tariff Commission Drops Investigation Covering Duty on Logs

The Tariff Commission, by a vote of four to two, has decided that it lacks jurisdiction to investigate costs of production of fir, cedar, spruce or western hemlock logs, mentioned in paragraph 401 of the tariff act of 1922.

Paragraph 401 imposes a duty of $1 per M. ft. b. m., on these logs, with the proviso that such logs shall be duty free if imported from any country which within a year has not imposed any embargo or restriction upon its own lumber exports. This conditional duty was aimed at export restrictions imposed by Canada.

The majority opinion held that the flexible provisions of the tariff act did not apply because upon certain conditions the logs could be entered free of duty.

Less Reconstruction in France. Four out of five largest American concerns operating in France, have withdrawn from the field because of belief that present French financial situation is unfavorable to building. Work is not extensive enough to further attract American builders and French claim ability to operate at lower costs.

Finland proposes to spend $16,500,000 on public works, railroads, harbors and hydro-electric resources. Recently $10,000,000 of Finland bonds were placed on the American market.

Conditions in Japan show that the reconstruction program will cover a period from 5 to 7 years. This will radiate prosperity to all part of the Empire.

Weekly Construction Market

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted.

Valuable suggestions on costs of work can be had by noting **actual biddings as reported in our Construction News section.**

The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the the issue of Nov. 1; the next, on Dec. 6.

Steel Products:	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Structural shapes, 100 lb.	$3.64	$4.00	$4.20	$3.40	$3.55	$4.20	$3.60	$4.10	$4.00
Structural rivets, 100 lb.	4.40	4.75	4.90	3.75	4.25	5.30	5.00	4.25	6.00
Reinforcing bars, ¾ in. up, 100 lb.	3.54	3.50	3.38	3.20	3.45	3.85	3.65	4.10	3.90
Steel pipe, black, 2½ to 6 in. lap, discount	44%	+40%	43%	47%	53–5%	36%	33.2@42.2%	35%	47.43
Cast-iron pipe, 6 in. and over, ton	63.60	+54.75	61.00	—57.20@60.20	60.50	69.00	—61.00	62.00	60.00
Concreting Material:									
Cement without bags, bbl.	—2.95@3.05	2.60	2.05	2.20	2.50	2.84	2.61	2.90	2.25
Gravel, ¾ in., cu.yd.	1.75	1.85	2.38	2.00	1.85	1.90	2.15	1.25	1.50
Sand, cu.yd.	1.25	1.24	2.00	2.00	+1.25	1.00	1.50	1.25	1.25
Crushed stone, ¾ in., cu.yd.	1.75	2.00	2.83	2.00	2.00	3.50	2.15	3.00	1.90
Miscellaneous:									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft.	—61.00	39.00	+54.75	—57.50	44.75@45.75	48.00	41.00	29.50	70.00
Lime, finishing, hydrated, ton	18.20	25.00	23.50	20.00	25.50	24.00	22.00	24.00	21.00
Lime common, lump, per bbl.	3.00@3.25	1.60	—1.85	1.50	1.50	2.70	2.10	2.80	9.50
Common brick, delivered, 1,000	—21.45@23.65	11.00	—11.00	11.00	—16@18	12.00	15.00	15.00	16.50
Hollow building tile, 4x12x12, per block	Not used	.102	—.110	.0724	—.075	.065	....	.11	.115
Hollow partition tile 4x12x12, per block	.1179	.102	—.110	.....	.....	.065	.108	.11	.....
Linseed oil, raw, 5 bbl. lots, gal.	.98	—.97	1.08	1.14	—.99	1.12	—1.08	+1.15	1.38
Common Labor:									
Common labor, union, hour	.75	.35	.....	.....	.....	.50@.55	.55	.62½	.....
Common labor, non-union, hour	....	.30	.30@.50	.82½	.50@.55	.35@.50	.50	.62½	—.30

Explanation of Prices—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or — signs. For steel pipe, the prevailing discount from list price is given: 45-5% means a discount of 45 and 5 per cent. Charge is 15c. per 100 lb. for cutting reinforced steel into 2-ft. lengths or over.

New York quotations delivered, except sand, gravel and crushed stone, alongside dock; common lump lime, in 280-lb. bbl. net, and hydrated lime f.o.b. cars; tile "on trucks"; linseed oil and cast-iron pipe f.o.b.

Labor—Concrete laborers' rate, 93½c.; building laborers (pick and shovel men) 75c. per hr.

Chicago quotes hydrated lime in 50-lb. bags; common lump lime per 180-lb. net. Lumber delivered on job.

Minneapolis quotes on fir instead of pine. Brick, sand and hollow tile delivered. Cement on cars. Gravel and crushed stone quoted at pit. We quote on brown lime per 180-lb. net; white is $1.80 for Kelly Island and $1.70 for Sheboygan. Common labor not organized.

Denver quotes on fir instead of pine. Cement "on tracks"; gravel and sand at pit; stone on cars; lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered, in iron bbl. Common lump lime per 180-lb. net.

Atlanta quotes sand, stone and gravel per ton instead of cu.yd. Common lump lime per 180-lb. net.

Dallas quotes lime per 180-lb. bbl. Steel, cement, cast-iron pipe and crushed stone f.o.b. cars, other materials delivered.

San Francisco quotes on Heath tile, size 5½ x 8 x 11½. Prices are all f.o.b. warehouses except C. I. pipe, which is mill price plus freight to railway depot at any terminal. Common lump lime per 180-lb. net. Lumber prices are to dealers in yards at San Francisco, for No. 1 fir, common.

Seattle quotes on Douglas fir (delivered) instead of pine. Lump finishing lime per 180-lb. net. Hollow building tile delivered. Hydrated lime in paper sacks. Sand and gravel at bunkers.

Montreal quotes on pine lumber. Sand, stone, gravel and lump lime per ton. Cement, lime and tile are delivered; sand, gravel and stone on siding; brick f.o.b. plant; steel and pipe at warehouse. Hollow tile per ft. Cement price is in Canadian funds (the Canadian dollar stands at 98.70). Bag charge is 80c. per bbl. Discount of 10c. per bbl. for payment within 20 days from date of shipment. Steel pipe per 100 ft. net; 3-in., $47.43; 6-in., $119.

Changes Since Last Week

The current market is characterized by irregularity both as to prices and conditions. The recent recovery in the stock market; an acceleration of retail trade; and the declaration of an extra dividend by the U. S. Steel Corporation are favorable indications.

These are offset, however, by the lack of development in steel demand; lower pig-iron prices, also due to falling demand, a sharp increase in the domestic business mortality; and curtailment in certain manufacturing industries.

Instances of price irregularity are shown in the recent advances in both steel and cast-iron pipe in Atlanta as compared with declines in San Francisco and Chicago. Pine timbers, at the same time, advanced $2.50 in Dallas and dropped $1 per M ft. in New York and Chicago. Linseed oil (an indicator of the paint trade) dropped 3c. in Atlanta, Minneapolis and San Francisco and rose sharply in Seattle. Lump lime, common brick and hollow tile, however, declined consistently in Dallas and Minneapolis as did cement, yellow pine lumber and common brick in New York.

The iron and steel situation may be described briefly as follows: No. 2 foundry iron quoted as low as $20@$21 per ton at Birmingham. Buyers not quite satisfied that bottom has been reached in iron prices. Coke declining with pig iron. Steel bars still $2.40, with structurals at $2.50 per 100 lb., Pittsburgh. Steel consumers show tendency to believe that prices have stabilized at present levels. A very small amount of cutting under is reported, mostly on steel sheets.